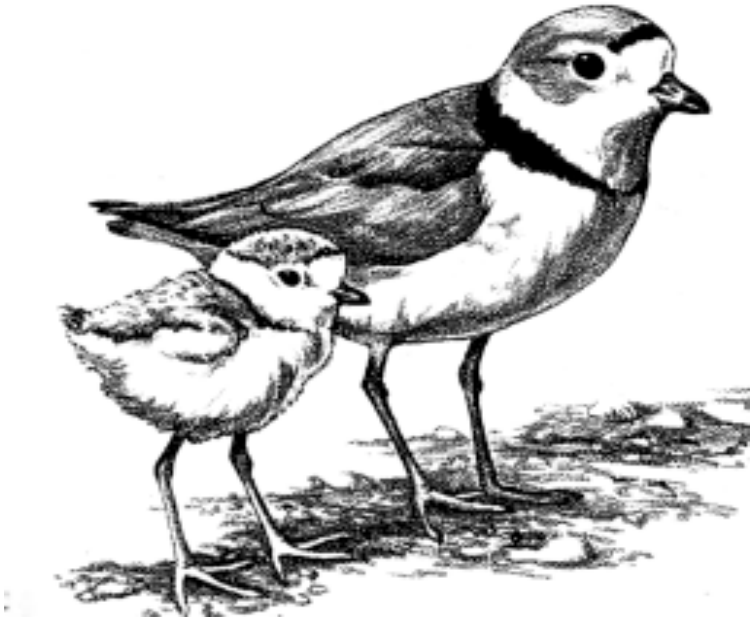
# Guide to Federally Listed Endangered and Threatened Species of

# North Carolina



# Guide to Federally Listed Endangered and Threatened Species of North Carolina

North Carolina Natural Heritage Program

Division of Parks and Recreation

1615 MSC

North Carolina Department of Environment and Natural Resources

Raleigh, NC 27699-1615

www.ncsparks.net/nhp

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2001


# TABLE OF CONTENTS

# PREFACE

The term "endangered species" most often evokes a mental picture of exotic animals like the panda or tiger. Rarely do we consider that many species in the United States and especially in North Carolina are in this category. At present, North Carolina is home to 5600 different species of plants, 935 species of vertebrate animals, and 1640 species of invertebrate animals. Of these, 758 species of plants and 644 of animals are presently considered rare, threatened, or endangered according to federal and state agencies and private conservation organizations. Among these rarities are unique and well-known organisms such as the Venus flytrap, which grows only on the Coastal Plain of North and South Carolina, and many lesser-known species of plants, mammals, reptiles and amphibians, insects, and molluscs.

Sixty-nine North Carolina species (animals and plant) are designated by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as federally endangered or threatened. The purpose of this publication is to provide landowners, environmental consultants, natural resource professionals, and the general public with information on 52 of these federally listed endangered and threatened species (the other 17 are marine species or extirpated species). An attempt has been made to use nontechnical terms whenever possible, though a glossary is provided. Both metric and English units of measure are used. Emphasis has been given to the distribution of the species and to habitat requirements. Recognized causes for species decline are given as well as recommendations for correcting these.

It is hoped that the information within this book will promote knowledge and understanding of the ecology of these species and their place in life's intricate web. Perhaps this knowledge will lead to awareness of and concern for native flora and fauna, and will encourage the active appreciation and effective conservation of the natural resources of North Carolina—the land, natural habitats, and the species themselves.

## The Endangered Species Act of 1973

The Federal Endangered Species Act (ESA) was enacted in 1973 to protect species in danger of extinction and to provide means for their recovery to safe population levels, thus preserving our nation's wealth of biological diversity. The need for such a law stemmed from the fact that "various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation . . ." and that others were "in danger of or threatened with extinction." Congress recognized that endangered species "are of aesthetic, ecological, educational, historical, recreational, and scientific value."

The three primary mechanisms of the ESA are (1) to determine which species should be federally listed as endangered or threatened, (2) to give them protection, and (3) to implement conservation measures to recover them so that they not longer need the protection of the ESA. *Endangered species* are defined as those in danger of extinction throughout all or a significant portion of their range, while *threatened species* are likely to become endangered in the foreseeable future. Subspecies and distinct populations of vertebrate animals can also receive protection under the ESA.

The listing of a species as endangered or threatened is a complex process requiring extensive review by government agencies, scientists, and the public. Once listed, endangered and threatened species are federally protected. Section 9 of the ESA makes it unlawful to trade listed species without a specially obtained permit. It is also illegal to "take" a listed animal species, which means to harass, harm, pursue, hunt, wound, kill, or capture, or to attempt any such activity. Listed plants are protected from removal, malicious damage, and destruction on federal property. The ESA also protects listed plants from the violation of any protective state laws on any other property, including the violation of state or criminal trespass law. (See section below on North Carolina's endangered species protection laws.)

Under Section 7 of the ESA, federal agencies are prohibited from issuing permits, funding, or carrying out any project if the project will jeopardize the survival of any listed species. Any agency planning a project in an area used by a listed species should first consult with the U.S. Fish and Wildlife Service, which is the regulatory agency for the ESA. (For marine species, consultation is made with the National Marine Fisheries Service.) A biological assessment describing impacts of the proposed project is required for consultation. Any projects that will jeopardize a listed species must be modified to avoid adverse impacts; exceptions are rarely made.

Private landowners are allowed some relief from the prohibitions of Section 9. Incidental take of a listed species may be permitted if the take is incidental to, and not the purpose of, an otherwise legal activity, and if the take will not jeopardize the continued existence of the species. For such a permit, a habitat conservation plan must be submitted to the Fish and Wildlife Service. If the plan is approved, some limited taking is allowed, provided the impact to the species is minimized and mitigated.

## North Carolina's Endangered Species Laws

North Carolina has its own laws that protect endangered and threatened species—one for animals and one for plants. These laws apply to species that are locally or regionally rare in the state in addition to those that are federally listed as endangered and threatened.

The N.C. Wildlife Resources Commission administers the N.C. Endangered Species Act (General Statutes 113-331–113-337; enacted in 1987), which protects animals, and maintains the state's list of "protected animal species." Under this law it is illegal to take, possess, transport, sell, barter, trade, or export any animal on the protected list without a permit. Though this law does not prohibit habitat modification, another state law (G.S. 113-291) does make it illegal to intentionally destroy or substantially damage wildlife nesting or breeding areas (for example, cutting down den trees, shooting into nests of animals or birds, etc). Data on these protected species are tracked by the N.C. Natural Heritage Program.

The North Carolina Plant Protection and Conservation Act was enacted in 1979 (G.S. Chapter 106, Article 19B; 202.12–202.22) to provide protection for the state endangered, threatened, and rare plants. This law is adminstered by the Plant Conservation Program in the N.C. Department of Agriculture. The Program maintains the list of endangered, threatened and rare plants, and data on these species are tracked by the N.C. Natural Heritage Program. As with the animals statutes, the plant state law prohibits the sale, barter, trade, exchange, or export of any plant on the state's protected list without a permit. However, agricultural, forestry, or development operations on private property are not regulated by this law, even though those actions may incidentally disturb rare plants, "so long as the plants are not collected for sale or commercial use" without a permit.

## Why We Should Be Concerned About the Loss of Species

Extinction is a natural process that has been occurring since long before the appearance of humans on the planet. Normally, new species develop through a process known as speciation at about the same rate that other species become extinct. However, because of air and water pollution, forest clearing, loss of wetlands, and other human-induced environmental changes, extinctions are now occurring at a rate that far exceeds the speciation rate. Since the Pilgrims landed at Plymouth Rock in 1620, more than 500 species, subspecies, and varieties of our nation's plants and animals have become extinct. By contrast, during the 3000 years of the Pleistocene Ice Age, all of North America lost only about 90 species.

All living things are part of a complex and interconnected network. The removal of a single species can set off a chain reaction that could affect many other species. For example, the loss of a single plant species can result in the disappearance of up to 30 other species of animals and plants. Each extinction diminishes the diversity and complexity of life on earth.

Furthermore, wild plants and animals are important to the development of new and improved medicines, agricultural crops, and other industrial products. One-quarter of all the prescriptions written in the United States today contain chemicals that were originally discovered in plants and animals. Industry and agriculture are increasingly making use of wild plants, seeking out the remaining wild strains of many common crops, such as wheat and corn, to produce new hybrids that are more resistant to disease, pests, and marginal climatic conditions. If these organisms had been destroyed before their values were known, their secrets would have died with them. When a species is lost, the benefits it might have provided are gone forever.

> *Wild lands and the plant and animal life that inhabit unique natural places are now dependent on us for survival. These natural places, with their diversity of life, can be enjoyed by and benefit all of us; with our help, they can be there for future generations.*
>
> *— U.S. Fish and Wildlife Service* Endangered Species Information Series: Mountain Sweet Pitcher Plant, *August 1995*

## What You Can Do To Help

- Visit arboretums, botanical gardens, and parks and learn all you can about plant and animal species, especially rare species, and the causes of their declines. Share what you have learned with others.
- Learn about basic ecological principles. Participate in the protection of our remaining wild lands and the restoration of damaged ecosystems. Encourage and participate in proper land use practices in your community.
- When hiking, tread lightly, and stay on designated trails in parks, gardens, and nature preserves. Take pictures and leave only footprints.
- Do not collect animals or plants from wild areas. Taking them out of their habitat deprives them of natural food sources and other life-sustaining resources.
- Don't collect or buy plants and animals collected from wild populations.
- Recycle as much as you can. As landfills become full, new ones are often placed in uninhabited areas, causing the destruction of hundreds of acres of wild habitat.
- Compost kitchen and garden waste and use as garden supplement and mulch. Reduce use of commercial chemical fertilizers and pesticides on gardens, lawns, farmlands, and golf courses. Practice organic farming and alternative pest control methods.

- Do not litter or pollute. Take part in stream and land cleanup projects.
- Conserve natural resources such as water and energy.
- Obey wildlife laws, especially those protecting rare species and habitat.
- Support and/or be a member of local, state, national, or international conservation organizations.
- Use the income tax checkoff to contribute to the NC Wildlife Nongame and Endangered Wildlife Fund.
- Purchase hunting and fishing licenses and duck stamps yearly even if you don't use them. Many of the revenues go to species and habitat protection.

—Adapted from *A Guide To Endangered and Threatened Species in Virginia* (Terwilliger et al., 1995) and Endangered Species Information Series (USFWS)

## Acknowledgments

Funding for this publication was provided by the U.S. Fish and Wildlife Service, Asheville Field Office. The volunteer efforts of Mary Frasier and James F. Shern, environmental consultants, resulted in a first draft of this publication. Over a period of seven years, the North Carolina Natural Heritage Program worked toward its completion under the oversight and persistence of staff member Susan Reece Giles. Laura Mansberg Cotterman was responsible for final copyediting and production.

Important sources used to compile the species accounts included the *Official World Wildlife Fund Guide to Endangered Species of North America* (Lowe et al. 1990), *Endangered and Threatened Plants and Animals of North Carolina* (Cooper et al. 1977), the U.S. Fish and Wildlife Service *Red Book of Endangered Species of the Southeastern U.S., Federal Register* (individual species) sections from the U.S. Fish and Wildlife Service, the Web site of the U.S. Fish and Wildlife Service, and the files of the North Carolina Natural Heritage Program. Many other publications and sources were also consulted. These and additional literature are listed in Appendix E.

Many individuals and agencies provided Illustrations. These are credited in Appendix F.

Appreciation is due to Nora Murdock of the U.S. Fish and Wildlife Service for technical assistance and review of this document. It should be noted that the information contained in this publication represents countless hours of fieldwork and research by many biologists. Their commitment to science and conservation is greatly appreciated.

# INTRODUCTION

## Definition of Legal Status

Federal status is designated by the U.S. Fish and Wildlife Service. Federally listed Endangered and Threatened species are protected under the provisions of the Endangered Species Act of 1973, as amended through the 100th Congress. Unless otherwise noted, definitions are taken from the *Federal Register*, Vol. 56, No. 225, November 21, 1991 (50 CFR Part 17).

**Endangered**
A taxon "which is in danger of extinction throughout all or a significant portion of its range"(Endangered Species Act, Sect. 3).

**Threatened**
A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (Endangered Species Act, Sect. 3).

**Federal Species of Concern** [also known as Species at Risk] "The service remains concerned about these species, but further biological research and field study are needed to resolve the conservation status of these taxa. Many species of concern will be found not to warrant listing, either because they are not threatened or endangered or because they do not qualify as species under the definition in the [Endangered Species] Act. Others may be found to be in greater danger of extinction than some present candidate taxa. The Service is working with the States and other private and public interests to assess their need for protection under the Act. Such species are the pool from which future candidates for listing will be drawn" (*Federal Register*, February 28, 1996). The Service suggests that such taxa be considered as "Species of Concern" or "Species at Risk," neither of which has official status.

**Threatened Due to to Similarity of Appearance (S/A)**
"Section 4 (e) of the [Endangered Species] Act authorizes the treatment of a species (subspecies or population segment) as endangered or threatened even though it is not otherwise listed as endangered or threatened if (a) the species so closely resembles in appearance an endangered or threatened species that enforcement personnel would have substantial difficulty in differentiating between the listed and unlisted species; (b) the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and (c) such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of the Act" *Federal Register*, November 4, 1997). The American alligator has this designation due to similarity of appearance to other rare crocodilians, and the southern population of the bog turtle has this designation due to similarity of appearance to the northern population of the bog turtle, which is federally listed as Threatened.

## Information Sources for Current Legal Status of Species

### For State Endangered and Threatened Species

**Regulatory Agencies**

*Animals (except insects)*
N.C. Wildlife Resources Commission
Department of Environment and Natural Resources
MSC 1700
Raleigh, NC 27699-1700
919-661-4872

*Plants and Insects*
N.C. Department of Agriculture
Plant Conservation Program
P. O. Box 27647
Raleigh, NC 27611
919-733-3610
*www.agr.state.nc.us/plantind/plant/conserv/cons.htm*

**Non-regulatory Agency**

*Animals and plants*
N.C. Natural Heritage Program
Department of Environment and Natural Resources
Division of Parks and Recreation
MSC 1615
Raleigh, NC 27699-1615
919-733-4181
*www.ncsparks.net/nhp*

### For Federal Endangered and Threatened Species

*Animals and Plants*
U.S. Fish and Wildlife Service
160 Zillicoa Street
Asheville, NC 28801

U.S. Fish and Wildlife Service
Ecological Services
551 Pylon Drive
Raleigh, NC 27606
*http://endangered.fws.gov*

## Guide to the Species Accounts

The species accounts that form the remainder of this book are organized by taxonomic grouping: first animals—subdivided into mammals, birds, reptiles, fishes, and invertebrates (the latter subdivided into mollusks-bivalves, mollusks-gastropods, and arachnids), and then plants—subdivided into vascular plants and nonvascular plants. Each account uses the following format:

**Name:** The common and scientific name are given. If there is more than one common name, or if the taxonomy is unclear, alternative names are given in parentheses.

**Federal status:** As of December 1, 2001. A species may change classifications if status is determined to be more or less at risk. Dates are given for enactment of present status. If this is a change in status, the original date and status are also listed.

**Description**: Average lengths are given. In some cases, English measurements were calculated from metric; such measurements were rounded off. Animal lengths are measured from head to tail. Leaf lengths do not include stem length. The flowering periods listed for plants indicate when flowering is most likely to take place. Flowers will not necessarily be visible for the entire period listed. (Note: abbreviations are used for centimeters [cm], meters [m], kilometers [km], hectares [ha], pounds [lb], and feet [ft],)

**Life History:** Reported habits and preferences for food, nesting/shelter, seasonal activities, breeding seasons, growth patterns and maturation, social styles and other characteristics are given for the general population of the species.

**Habitat:** Known habitat preferences are given. Species may be found in other habitats as well.

**Distribution:** Range and counties in which the species is known to occur within North Carolina only. If a species is discovered in a new county, it should be reported to state and/or federal authorities. *Counties in which the element was last observed more than 20 years ago (1979 or earlier) are marked with an asterisk (*). The asterisk does not necessarily mean that the species is no longer known from that county, only that the date of the last observation available to the Natural Heritage Program and/or USFWS from that county is at least 20 years old. Counties listed in brackets [ ] indicate records listed by data bases at the North Carolina State Museum of Natural Sciences and may be older records.* Occasionally areas in neighboring states are included as well. Fishes and aquatic invertebrates are noted for counties where they are known to occur.

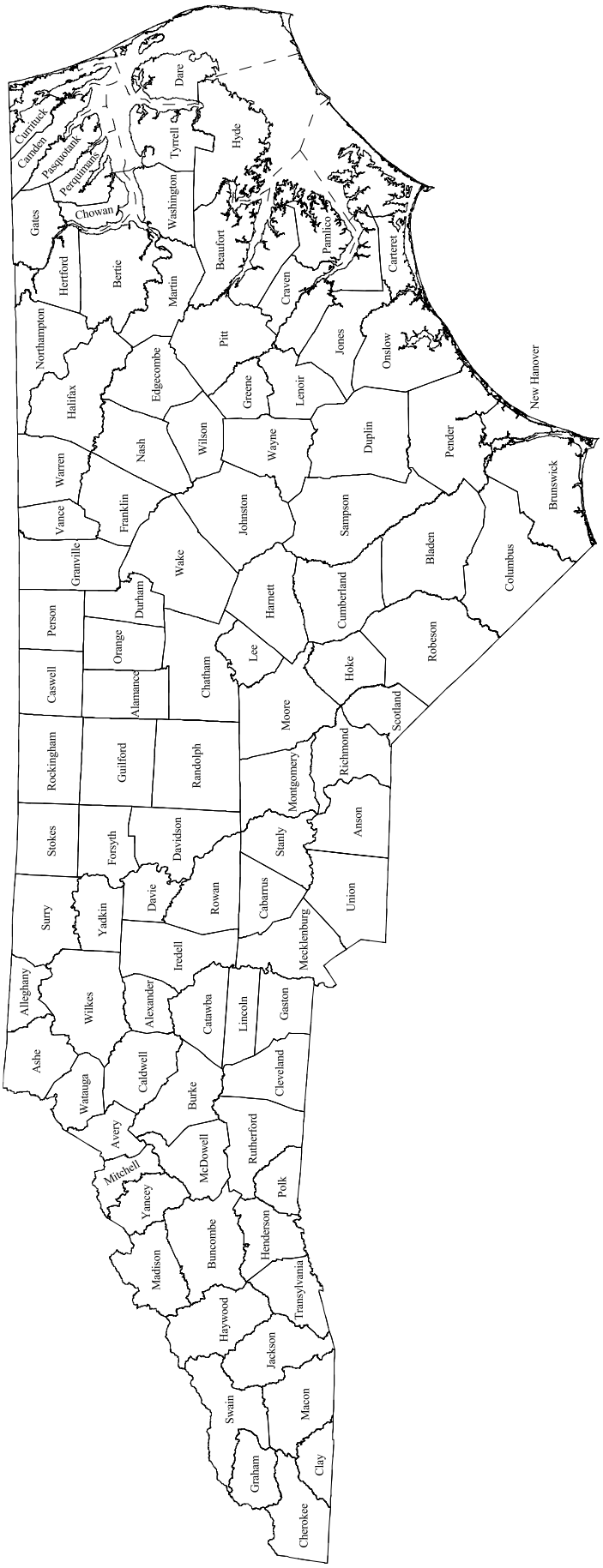
Sea turtles occur in coastal waters and nest along beaches. This publication includes sea turtles in the counties where they are known to nest. The USFWS has jurisdiction over sea turtle issues on terrestrial systems; the National Marine Fisheries Service has authority over sea turtles in coastal waters. Manatees occur throughout North Carolina's coastal water; this publication includes manatees in counties where there are known concentrations. The USFWS has consultation and recovery responsibility for manatees.

**Threats:** Circumstances that have put species on protected list; potential threats to present and future success of species.

**Recommendations:** Protective measures that are recommended to protect species and/or habitat to maintain success of species, correct negative impacts, or prevent future negative impacts.

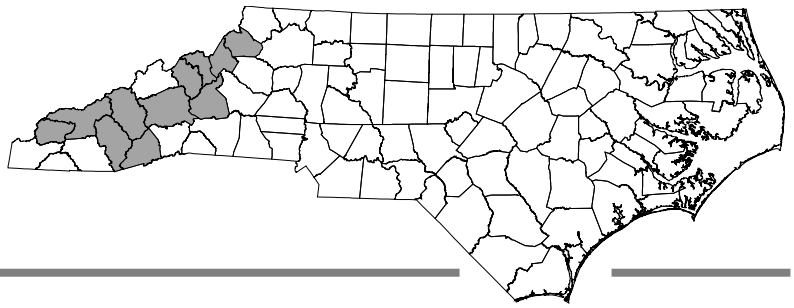
**Sources:** See Appendix E for full citations. USFWS = U.S. Fish and Wildlife Service.

## North Carolina Counties



# Carolina northern flying squirrel

*Glaucomys sabrinus coloratus*
Endangered (July 1, 1985)



**Description:** This nocturnal squirrel is medium-sized, 10-12 inches (26-30.5 cm) in total length, with a broad, flattened tail, prominent large black eyes, and dense silky fur. The patagia, a large fold of fully haired skin, runs from the front legs to the hind legs and enables the squirrel to glide, a characteristic of this genus. The squirrel is brownish or grayish on the back, with a whitish underside. Juveniles have slate gray backs. Northern flying squirrels are larger than Southern flying squirrels *(G. volans),* and have hairs on the stomach that are gray at the base, while those of the Southern flying squirrel are whitish from tip to base.

**Life History:** Is omnivorous, subsisting on lichens, hypogenous fungi as well as seeds, buds, fruit, staminate cones, catkins, tree sap, and insects.

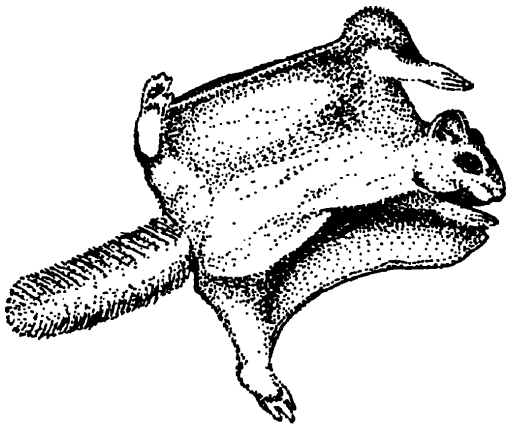
**Habitat:** Favors the ecotone between coniferous (red spruce and Fraser fir) and mature northern hardwood forests (beech, yellow birch, maple, hemlock, red oak, and buckeye). Also inhabits northern hardwood with hemlock in the absence of spruce and fir. Prefers moist forest with widely spaced, mature trees and moderate to thick evergreen understory, and large numbers of dead snags. Elevations are usually above 4500 ft (1400 m), or narrow, north-facing valleys above 4000 ft. (1200 m). Dependence on fungi may be a factor in restricting species to cold, moist, high elevations. In winter, squirrels inhabit tree cavities in older hardwoods, particularly yellow birch (*Betula alleghaniensis*). Leaf and twig nests ("drey" nests) are used primarily in summer and are usually found in the limbs of spruce trees. Colonies aggregated in island-like distribution.

**Distribution**: A Southern Appalachian subspecies, it is isolated in localities in Avery, Buncombe, Graham, Haywood, Jackson, Mitchell, Swain, Transylvania, Watauga, and Yancey counties.

**Threats:** Habitat destruction from logging, clear cutting, certain forest management practices, and recreational development has adversely affected populations, in some cases by allowing displacement by more aggressive *G. volans* in areas where the two species' ranges overlap. Infection by the parasitic nematode, *Strongyloides,* carried by the Southern flying squirrel, is also a threat.

**Management Recommendations:** Preservation of high elevation forests and bogs, including both spruce-fir stands and adjacent zones of northern hardwood vegetation.

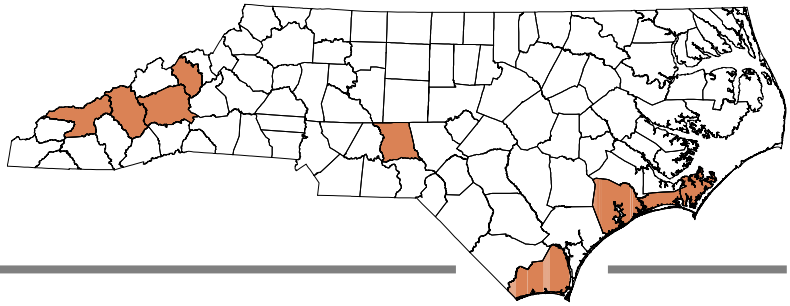
*Sources: Cooper et al. 1977, Murdock pers. com., Terwilliger et al. 1995, USFWS 1992a, Weigl 1987.*



# Eastern cougar

*Felis concolor couguar*
(Panther, mountain lion, puma)

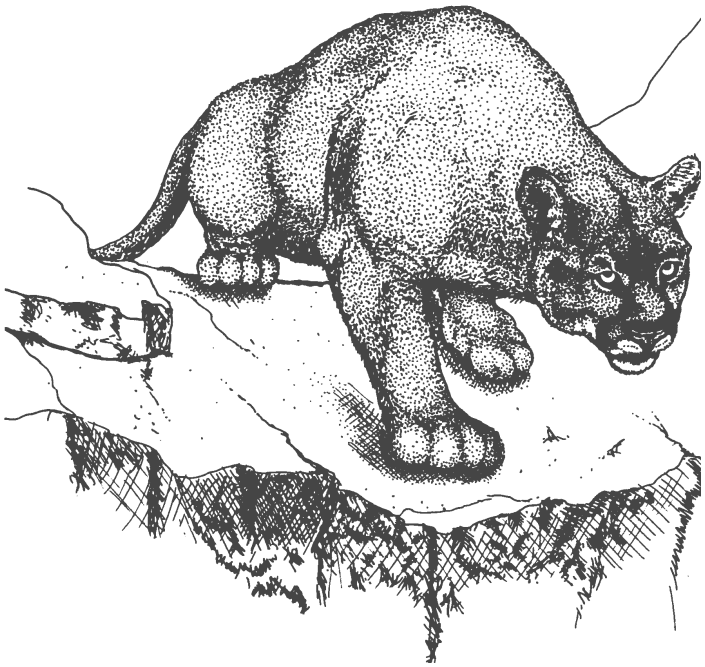
Endangered, possibly extirpated
(June 4, 1973)



**Description:** This large, long-tailed cat may measure up to 7.5 ft (2.3 m) in total length and 150 lb. (67.5 kg) at adulthood. Fur is light yellowish to tawny brown, with dull white underparts. The sides of the muzzle, the backs of the ears, and the tip of the tail are dark brown to black. Paw prints are up to 4 inches (10 cm); the claws are retractable and therefore are usually not seen in paw prints. Cubs are light brown with irregular brownish to black spots and a ringed tail.

**Life History:** Cougars are solitary, mostly nocturnal, and active in all seasons. They are adept at climbing but stalk prey and leap upon it from the ground. Preferred food is deer, but they will prey upon rabbits, rodents, turkey, squirrel, beaver, fish, birds, and arthropods. An adult may require 25-50 square km area for range. Females mature at 2-3 years; males mature at 4-5 years. Females breed at 2-3 year intervals and produce one to four cubs after 90 days gestation. Cubs disperse after 2 years with mother. Cougars normally shun human contact and attacks are extremely rare.

**Habitat:** Remote areas with dense vegetation and rocky crevices, such as hilly woodlands, mountains, gorges, and Southern swamps with large deer populations. Often uses caves as temporary shelter. Home range depends on age, sex, reproductive status, and food availability.



**Distribution:** Historically the most widespread mammal of North America and statewide in North Carolina. May exist in remote areas of the coastal plain and mountains. Within the last couple of decades, undocumented sightings have been reported from the Great Smoky Mountains National Park, Pisgah and Nantahala National Forests, the Blue Ridge Parkway, northern portions of Uwharrie National Forest, and from southeastern counties. Sightings are usually fleeting, in poor light, and lack definition. The U.S. Fish and Wildlife Service, U.S. Forest Service, and National Park Service have conducted tracking surveys and constructed scent stations, but have found no hard evidence of eastern cougars to date. Some of the animals that have been reported have been escaped or released pets of the non-endangered western subspecies. Records indicated in Brunswick*, Buncombe*, Carteret*, Haywood*, Montgomery*, Onslow*, Swain*, and Yancey* counties.

**Threats:** Destruction of habitat by residential, commercial, and recreational development. Intentional eradication of species by hunting, poisoning, and trapping may have extirpated species from state. Severe reduction of white-tailed deer herds would also have adversely affected this species.

**Management Recommendations:** Set aside extensive wild areas as in designated national forest where vast wilderness provides undisturbed habitat and sufficient white-tailed deer population.

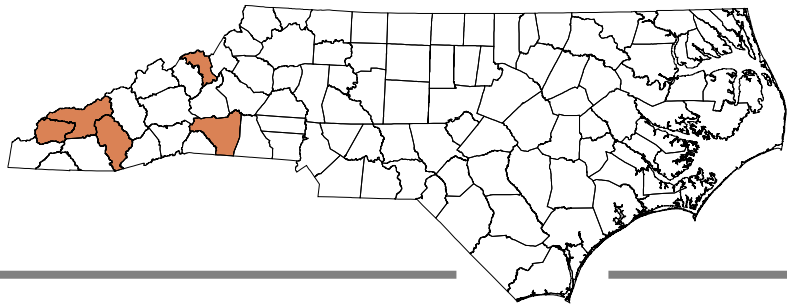
** No record has been reported in the county in the past 20 years.*

*Sources: Cooper et al. 1977, Lee 1987, Linzey 1995, Murdock*

# Indiana bat

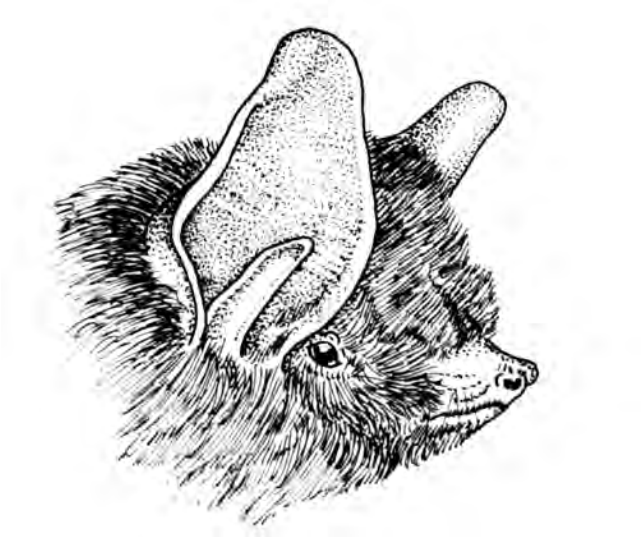
*Myotis sodalis*

Endangered (March 11, 1967)



**Description:** The Indiana bat is one of the smallest bats in the state with a total length of 3.5 inches. It has mouselike ears and a plain nose with dull, grayish brown fur on the back and lighter cinnamon brown on undersides. However, coloration can be variable and cannot be relied upon solely for species identification. The little brown bat, *M. lucifugus*, is easily confused with the Indiana bat. The following characteristics distinguish the two species: (1) The Indiana bat has short toe hairs, while the little brown bat's are long. (2) The Indiana bat's fur is dull, while the other's is glossy. (3) The Indiana bat has a light-colored nose, while the other's is dark. (4) The Indiana bat's hair appears tri-colored (black at base, gray in middle, brown at tip), while the other's is bi-colored. (5) The calcar, a bone leading to the foot, is keeled in the Indiana bat, but not in the little brown bat.

**Life History:** The Indiana bat is nocturnal, feeding on moths, mayflies, and other insects found over tree-lined streams and over the tops of trees in upland woods. Five hundred to five thousand bats will congregate into compact clusters aggregated at the entrance to limestone caves. They will migrate up to 300 miles to return to winter caves in September. They hibernate from early October until late March and April, then migrate to summer roosts. Mating occurs in fall at the beginning of hibernation. Sperm is stored in the uterus until spring when fertilization takes place. Females produce a single offspring in June. Gestation period is not known.



**Habitat:** From fall to spring, Indiana bats hibernate in large clusters in limestone caves and old mines, usually where there is a water source close by. Most males use the same caves year-round, while females and young (maternity colonies) roost under loose bark and in tree hollows of shagbark hickory and oak near small-to medium-sized streams. Old buildings and undersides of bridges are sometimes used. Summer foraging habitat is in riparian and floodplain areas. Males also forage in hillside forests.

**Distribution:** This species is found primarily in the Ohio Valley where limestone caves are numerous; is a rare migrant and winter and summer visitor to North Carolina and is usually seen singly or in very small numbers. Records in Graham, Jackson*, Mitchell*, Rutherford, Swain counties in the mountain region, where caves are present.

**Threats:** Disturbance of cave colonies. Human disturbance includes intentional destruction from burning, stoning, clubbing, and shooting of the dormant bats as well as noise from cavers, scientific research, and cave commercialization. These types of disturbance, if not fatal initially to the bat population, will cause loss of body fat and resulting starvation before spring migration. Additional disturbances include flooding of caves and pesticide poisoning of insects that bats prey upon.

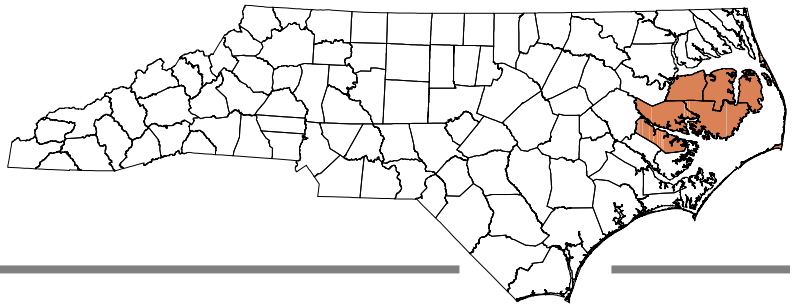
**Management Recommendations:** Protection of habitat, especially hibernacula from disturbance and destruction.

* *No record has been reported in this county in the past 20 years.*

*Sources: Adams 1987, USFWS 1992a.*

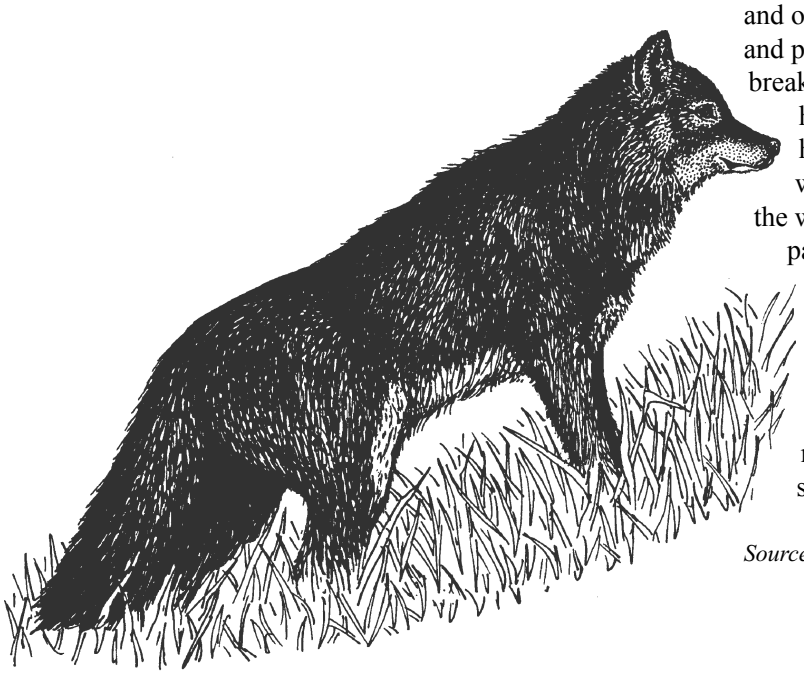
# Red wolf

*Canis rufus*
Endangered (March 11, 1967)



**Description:** The red wolf is a slender canid between the coyote (*C. latrans*) and the gray wolf (*C. lupus*) in size, with large ears and long legs. Adults weigh 40-80 lb (18-36 kg). Coloration varies from red to yellow, gray, black, or brown and may be mottled. The fur is slightly tawnier and coarser than that of the coyote and the gray wolf. The red wolf holds its bushy tail high while running unlike the coyote, which tucks its tail between its hind legs.

**Life History**: The wolves usually travel in family groups of 2 or 3, but lone individuals are also seen. Red wolves are opportunistic predators, feeding on small mammals and deer, and do not hunt in packs. It is thought that red wolves mate for life and both parents take part in rearing the young. They exist as small family units (packs) of an adult pair and their young with the offspring dispersing at about 6-12 months. Breeding occurs in February and March, and pups are born in April and May. The average litter size is 4-5 young.



**Habitat:** On the North Carolina coastal plain, red wolves prefer areas with heavy vegetation for cover, such as fallow fields, marshes, pocosins, and swamps. They were also known to prefer dense forests in mountains and bottomlands before they were eliminated in the wild. They will excavate dens in sand knolls in coastal areas but will also den in hollow trees and culverts.

**Distribution:** Red wolves were completely extirpated in the wild by the 1970s. In North Carolina, they have been reintroduced into the Alligator River National Wildlife Refuge and the Pocosin Lakes National Wildlife Refuge in Dare, Washington, Tyrrell, and Hyde counties by the U.S. Fish and Wildlife Service. They are also found in Beaufort County.

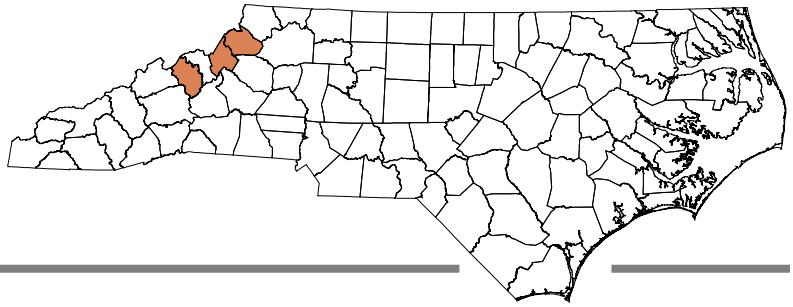
**Threats:** Expanding human populations and extensive land clearing eliminated much of the red wolf habitat. Large numbers of this species and other large predators were intentionally destroyed by hunting, trapping, and poisoning. Even today there is willful killing of wolves by local farmers and other citizens concerned about the loss of farm animals and pets to wolf predation. This extermination causes a breakdown in the red wolf social structure. Habitat changes have encouraged expansion of the coyote range into historically red wolf territory, resulting in interbreeding with unmated wolves, thus threatening the gene pool of the wolves. Breeding with coyotes may also introduce parasitic infections, which weaken the fecundity of existing wolf groups.

**Management Recommendations:** Education of the public about the importance of the red wolf in the ecosystem. Protection of existing family units. Maintenance of adequate habitat in undisturbed wilderness such as national forests and wilderness preserves.

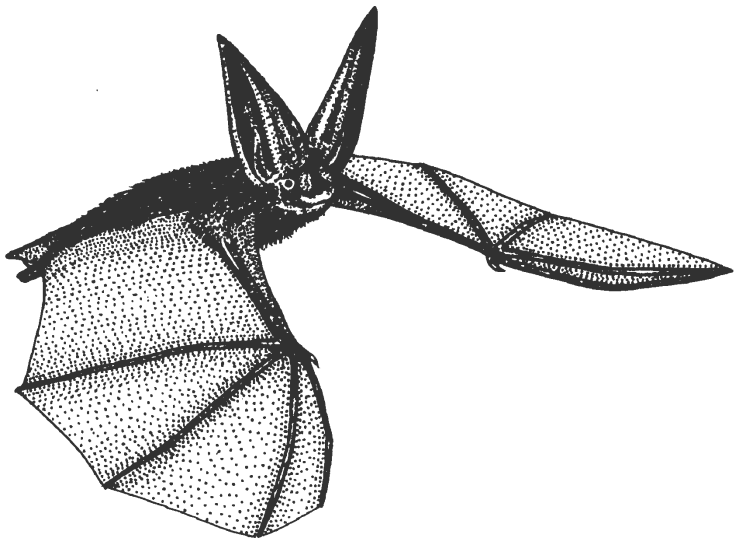
*Sources: Jackson et al. 1992, Lowe et al. 1990, USFWS 1992a.*

# Virginia big-eared bat

*Corynorhinus (=Plecotus) townsendii virginianus*
Endangered (November 30, 1979)



**Description:** Two species of big-eared bats occur in North Carolina. The Virginia big-eared bat is a medium-sized bat with large ears connected by a low band across the forehead and with a globular shaped mass on the muzzle and elongated nostrils. The other species is Rafinesque's big-eared bat (*Corynorhinus [=Plecotus] rafinesquii*), a Federal Species of Concern. The ears of these two species distinguish them easily from all other bats in the state. Over 1 inch (2.5 cm) long, the ears are twice as high as those of other species. When the bats are at rest, the ears are curled alongside the head and reach back to half the length of their body. Although it is unlikely the two species overlap in range, the following characteristics can be used to distinguish between them: (1) The fur of the Virginia big-eared bat is long, soft, and a uniform color from base to tip, while that of Rafinesque's big-eared bat is bi-colored. (2) The toe hairs of Rafinesque's big-eared bat extend past the toes, while the Virginia big-eared bat's do not. (3) The ventral fur of the Virginia big-eared bat is light brown, while that of Rafinesque's big-eared bat is whitish.



**Life History:** In winter, individuals of this species hibernate rather than migrate. They roost alone or in small clusters along ceilings and walls near the mouth of caves where there is air movement. In the spring and summer, females form maternity colonies in warm caves while males are usually solitary. Mating occurs in fall and winter and a single young is born in June. Nocturnal feeders, they wait until well after dark to forage for moths, beetles, flies, wasps, and winged ants.

**Habitat:** Non-migratory, these bats live year round in caves or old mines, although summer and winter roosts may differ. Caves are usually located in mountainous limestone regions over 1500 feet elevation where the dominant trees are oak and hickory, or beech, maple, and hemlock. Most known roost sites have been closed off with gates to prevent disturbance.

**Distribution:** Fragmented into several populations, these bats are found in Avery, Watauga, and Yancey counties in the mountain region.

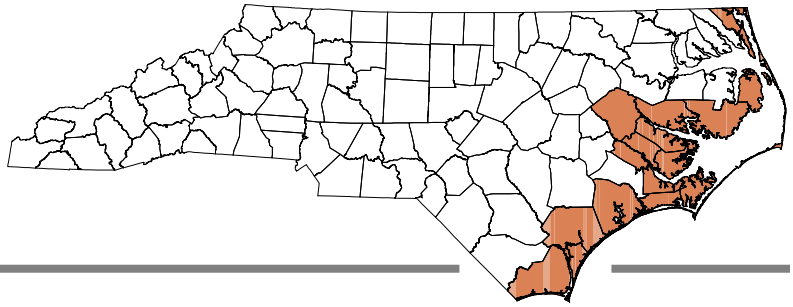
**Threats:** Habitat disturbance from noise, bright lights, or human presence has caused several winter colonies to disappear.

**Management Recommendations:** Protection of caves and other habitat from interference by cavers, sightseers, and other human activity.

*Sources: Clark 1987a; Terwilliger et al. 1995; USFWS 1992a, 1992b; Webster et al. 1985.*

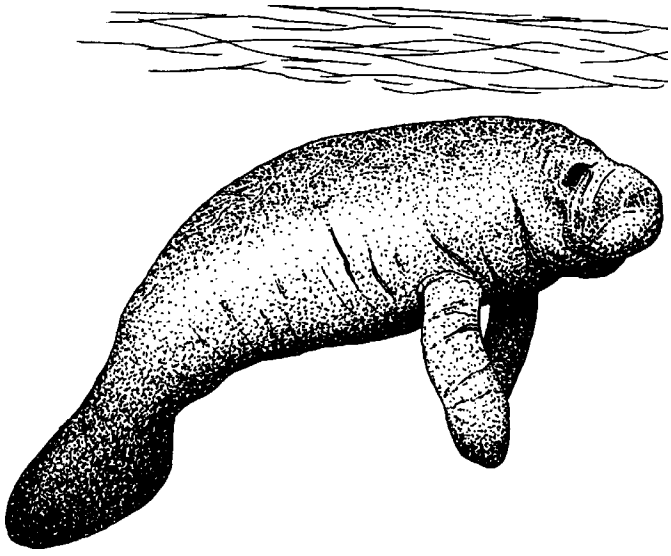
# West Indian manatee

*Trichechus manatus*
Endangered (June 2, 1970)



**Description:** The manatee is a massive, barrel-shaped aquatic mammal with a broad head and large stiffly bristled, fleshy lips that overhang and hide the lower jaw. Both the eyes and external ears are minute in relation to body size. The tough, 2-inch-thick skin is uniformly gray to gray-brown, wrinkled, and nearly hairless. It is often scarred and covered with barnacles, algae, and other crustaceans. The forearms are short and paddle-like and are used for locomotion, scratching, touching and embracing other manatees, manipulating food, and cleaning their mouths. Hind limbs are lacking and the tail is horizontally flattened and rounded. Adults are 7-13 ft long and may weight 11,000-13,000 lb. Sexes are distinguished by the position of the genital opening and presence or absence of mammary glands.

**Life History:** Manatees are essentially solitary animals, but will exist in loosely organized groups of 2-6. The strongest social unit is the family, which consists of a cow and calf. Fecundity is low with no definite breeding season known. Sexual maturity is reached between 4 and 9 years. Females usually breed once every 2.5-3 years, producing one calf after 11 months of gestation. Young remain with the mother for several years. Herbivorous, they consume almost exclusively submerged aquatic vegetation but sometimes eat shoreline vegetation. They spend 5 hours a day feeding and may consume 4-9% of the body weight in 1 day. They may not need fresh water but have been observed drinking fresh water from hoses, culverts and sewage outfalls. They often feed at night, locating food by touch and smell.



**Habitat:** Wholly aquatic, manatees inhabit warm shallow seas near shore, salt water bays, and estuarine habitats. They live in both fresh and salt water and move up sluggish rivers and canals for variable distances. Factors that influence habitat choice are (1) availability of food, (2) sufficient water depth of 1.5 to 6 m, (3) access to warm water during cold winter weather, and (4) source of fresh water required for osmoregulation.

**Distribution:** The manatee is known from shallow waters of subtropical regions of the Atlantic coast ranging from coastal North Carolina to the Florida Keys, Gulf of Mexico and west to the Louisiana coast. Habitat is restricted to warm waters. They are migratory and have been recorded in North Carolina waters from June to October. They may overwinter in warm water discharges from coastal North Carolina power plants from October to April. Reported in Beaufort, Brunswick, Carteret, Craven, Currituck, Dare, Hyde, New Hanover, Onslow*, Pamlico, Pender, and Pitt counties.

**Threats:** The greatest enemy to manatee survival is humans. Collisions with motor boats and propellers cause the greatest numbers of injuries and death to these slow swimmers. Other threats to the species are predation by humans for hide, meat, and oil; harassment by swimmers and boaters; death from entanglement and drowning in fishing nets, lines and floodgates; and loss of habitat to pollution, dredging, and filling.

**Management Recommendations:** Enforcement of laws against death and injury, pursuit, and harassment. Protection and restoration of habitat.

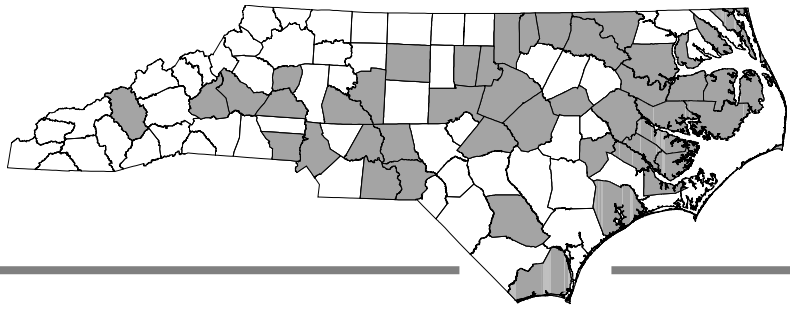
** No record has been reported in this county in the past 20 years.*

*Sources: Clark 1987b, Cooper et al. 1977, Terwilliger et al. 1995, Webster et al 1985.*

# Bald eagle

*Haliaeetus leucocephalus*

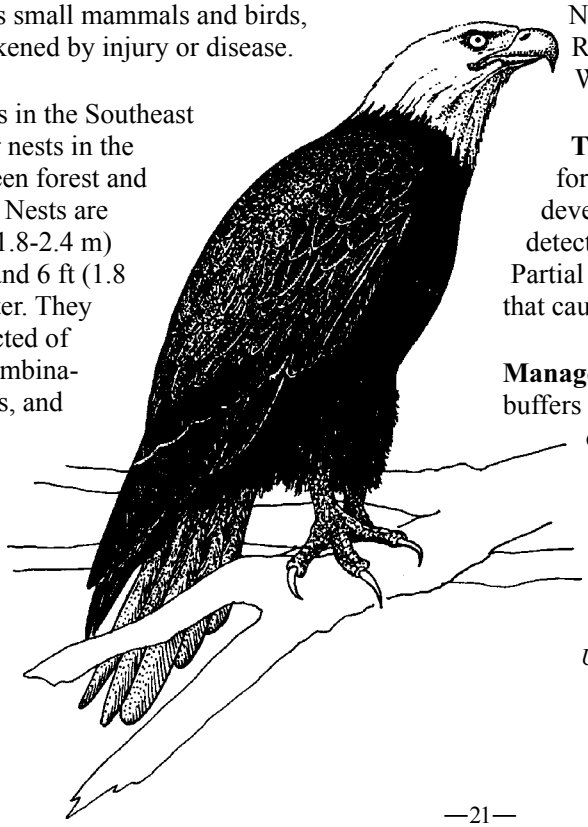
Threatened (August 11, 1995; originally listed as Endangered on March 11, 1967; proposed for delisting, July 6, 1999)



**Description:** Bald eagles are large raptors, 32-43 inches (81-109 cm) long, with a white head, white tail, yellow bill, yellow eyes and feet. The lower section of the leg has no feathers. Wingspread is about 7 ft (2.1 m). The characteristic plumage of adults is dark brown to black with young birds completely dark brown. Juveniles have a dark bill, pale markings on the belly, tail, and under the wings and do not develop the white head and tail until 5-6 years old.

**Life History:** Bald eagles do not adapt well to changes in their habitat and this results in relatively low reproductive rates. They are not sexually mature until the age of 4-5 years, when they mate for life or until the death of a mate. In North Carolina, nest building takes place in December and January, with egg laying (clutch of 1-3 eggs) in February and hatching in March. Incubation lasts 35 days. Hatchlings attain adult size in 8 weeks. They are opportunistic feeders consuming a variety of living prey and carrion. Up to 80% of their diet is fish, self caught, scavenged, or robbed from osprey. They may also take various small mammals and birds, especially those weakened by injury or disease.

**Habitat:** Bald eagles in the Southeast frequently build their nests in the transition zone between forest and marsh or open water. Nests are cone-shaped, 6-8 ft (1.8-2.4 m) from top to bottom, and 6 ft (1.8 m) or more in diameter. They are typically constructed of sticks lined with a combination of leaves, grasses, and Spanish moss. Nests are built in dominant live pines or cypress trees that provide a good view and clear flight path, usually less than 0.5 mile (0.8 km) from open water. Winter roosts are usually in dominant trees, similar to nesting trees, but may be somewhat farther from water.



**Distribution:** Eagles range across North America but are most common in Alaska. In 1985 there was just a single active nest in NC, but by 2001, there were 34 nesting pairs in the state. Although most nests are in the lower coastal plain near estuaries, several are present at Piedmont foothills and lakes. Non-nesting eagles are most abundant in the northern coastal plain and along the Pee Dee-Yadkin River system, where they occur year-round. Winter and summer roosts have also been established at several Piedmont reservoirs. Eagles may be nesting at Mattamuskeet National Wildlife Refuge, where a hacking program released 33 eagles by 1990 (Lee and Parnell 1990). They are reported in Anson, Beaufort, Bertie, Brunswick, Burke, Chatham, Chowan, Craven, Currituck, Dare*, Davidson, Durham, Gaston, Granville, Guilford, Harnett, Haywood, Hyde, Johnston, Lenoir, Martin, McDowell, Mecklenburg, Montgomery, Northampton, Onslow, Pamlico, Pasquotank, Pitt, Richmond, Rowan, Stanly, Tyrrell, Vance, Wake, and Washington, Wilson counties.

**Threats:** Disturbance and destruction of roosting, foraging and nesting habitat by urban and residential development. Avian vacuolar myelinopathy (AVM), first detected in 1994, which impairs flight and results in death. Partial recovery of species is due to prohibition of pesticides that caused death and low viability of eggs in reproduction.

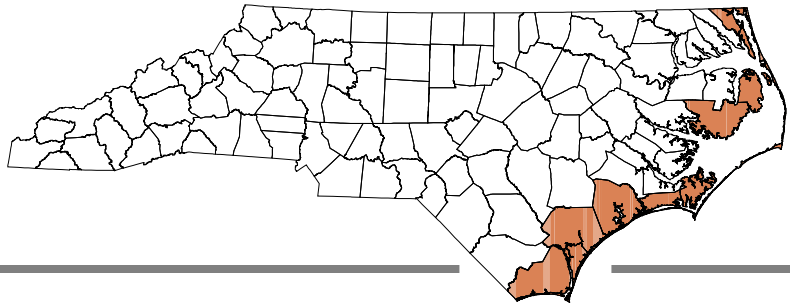
**Management Recommendations:** Protection of vegetative buffers on shorelines of lakes, rivers, and reservoirs where development is encroaching; restoration of habitat; and protection of good water quality. Enforcement of protection of species from hunting and harassment.

** No record has been reported in this county in the past 20 years.*

*Sources: Henson 1990, Potter et al. 1980, USFWS 1992a., USGS 2001.*

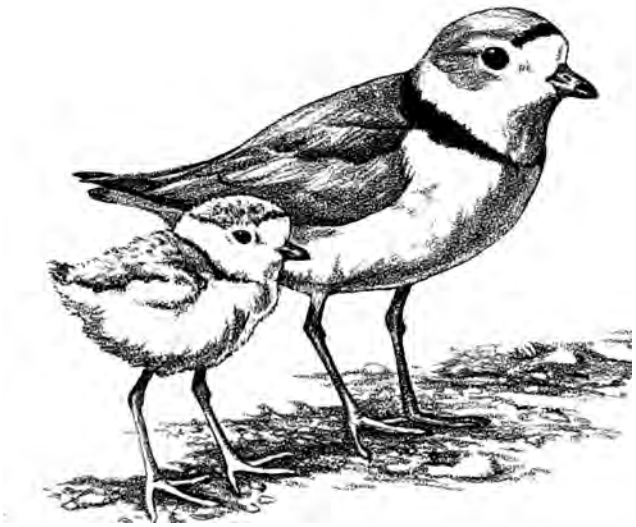
# Piping plover (Atlantic)

*Charadrius melodus melodus*
Threatened (December 11, 1985)



**Description:** The piping plover is a short stocky bird a little larger than a sparrow, 6-7 inches (15-17 cm) in total length. Coloration is pale gray-brown on the back and top of the head, with white underparts and a complete or partial band of black around the neck. A black band also crosses the forehead, but becomes obscure in winter. The legs are yellow-orange; the bill is yellowish in spring and dark in autumn. Call is a whistled "peep-lo."

**Life History:** Like most plovers, the piping plover runs in short starts and stops. It eats worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates plucked from the sand. Plovers arrive on breeding grounds in March-April. After courtship rituals and establishment of nesting territories, nests are made in small depressions in the sand and lined with bits of shells or pebbles. Four buff-colored eggs peppered with dark marks are laid. Eggs hatch after 27-31 days incubation. If the first clutch is lost early, a second set of eggs is laid. By September both adults and young depart for wintering areas.



**Habitat:** In North Carolina, barrier island beaches are used as nesting sites. Preferred sites are sparsely vegetated areas on high ground near inlets or wash-over fans with a pond or slough, or ocean edge nearby. During migration and winter, piping plovers can be found along sandy beach shoals, primarily on outer beaches and inner sand or mud flats.

**Distribution:** North Carolina lies at the southern end of the breeding range and at the northern end of the wintering range, and thus is the only state with both breeding and wintering populations. Breeding birds occur in scattered locations throughout the North Carolina coast, mostly on the barrier islands between Cape Lookout and Cape Hatteras. They are reported as nesting in Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, and Pender counties.

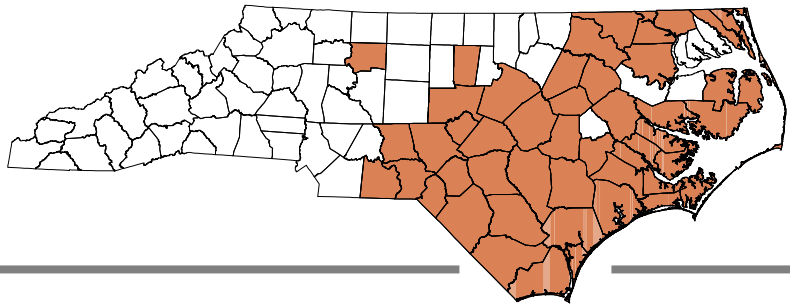
**Threats:** Primary threats are habitat alteration and destruction from development, and disturbance of nesting adults and flightless chicks by humans and unleashed dogs, and in some areas, by vehicles driving on the beach. Many nests are also lost to predation by a wide variety of animals, such as gulls, crows, ghost crabs, raccoons, foxes, feral cats, and other animals.

**Management Recommendations:** Protection and preservation of undisturbed breeding and wintering habitat. Restriction of vehicular and pedestrian traffic in breeding areas. Predator exclusion devices are recommended on some beaches.

*Sources: Golden and Parnell 1990, Lee 1990, Mignogno pers. com, Potter et al.1980, USFWS 1992a.*

# Red-cockaded woodpecker

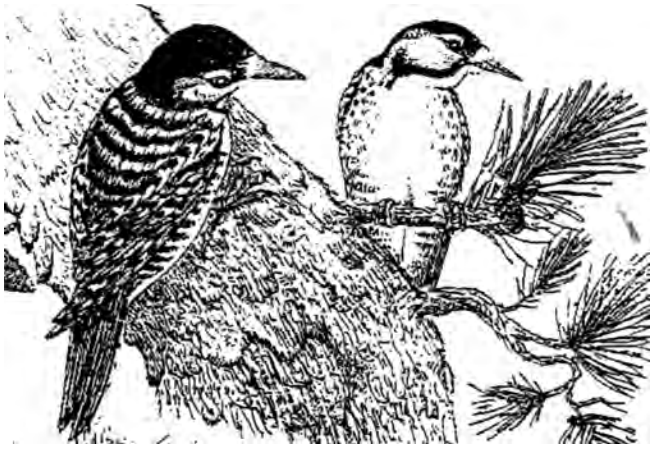
*Picoides borealis*
(RCW, term often used by biologists)
Endangered (October 13, 1970)



**Description:** The red-cockaded woodpecker is 8 inches (18-20 cm) long with a wing span of 15-19 inches (35-38 cm). It has a black cap and is black on the nape of its neck. The back is horizontally barred with black and white and the underside is white with black spots on the sides. There is a large white patch on each cheek, which is a distinguishing characteristic from other woodpecker species. The male has a small red spot behind the eye, which is usually not visible. Fledgling males have a red patch on the crown of the head.

**Life History:** RCWs live together in family groups, but each adult has its own roost cavity. Foraging takes place during the day; birds return to their roost cavities at dusk. Their diet consists of ants, beetles, wood-boring insects, caterpillars, and corn ear worms as well as seasonal wild fruit. Eggs are laid in April through June in the male's roosting cavity for nesting. An average clutch is 3-5 with a maximum of 7 eggs. Rearing the young is a shared group responsibility. The group, 3-5 birds, is composed of parent birds and male offspring from previous years.

**Habitat:** The preferred habitat of RCWs is open, park-like pine stands with little undergrowth. Habitats range from savannas and flat woods in the lower coastal plain to rolling, xeric uplands in the sandhills. They are also found in pond pine pocosins in the northeastern coastal plain. The largest populations are found in forests of longleaf pine, but loblolly, shortleaf, pond, slash, and occasionally Virginia and pitch pine are also used. Living pines (30+ years old) are preferred for foraging habitat, and mature, live trees (60+ years old), especially those infected with a fungus producing red-heart disease, are used for roosting and nesting cavities. The territory of a group of birds is at least 125-175 acres (50-70 ha) in size; normally they do not travel more than 0.5 mile to forage. RCWs are the only birds to regularly excavate cavities in live southern pines, although other birds are known to nest in dead limbs of live trees. Cavity trees are often highly visible, as the birds peck the bark around the cavity, causing the tree to ooze large amounts of light-colored sap. The birds keep the sap flowing apparently as a defense mechanism against rat snakes and other predators which find the sap irritating to their skin.



**Distribution:** The southeastern states from southern Virginia to eastern Texas, with the great majority of populations occurring on the Atlantic and Gulf coastal plains. In North Carolina, found mostly in the sandhills and southern coastal plain; scattered populations also live in the northern coastal plain and the eastern piedmont. Found in Anson, Beaufort, Bertie, Bladen, Brunswick, Camden*, Carteret, Chatham*, Columbus, Craven, Cumberland, Currituck*, Dare, Duplin, Edgecombe*, Forsyth*, Gates, Greene, Halifax*, Harnett, Hertford*, Hoke, Hyde, Johnston, Jones, Lee*, Lenoir*, Montgomery, Moore, Nash*, New Hanover, Northampton*, Onslow, Orange*, Pamlico, Pender, Pitt*, Richmond, Robeson, Sampson, Scotland, Tyrrell, Wake*, Wayne, and Wilson* counties.

**Threats:** Loss of habitat through logging, residential and commercial development, forestry management practices such as conversion of old longleaf pine stands to short-rotation, densely stocked stands of other species, and suppression of periodic fire regime.

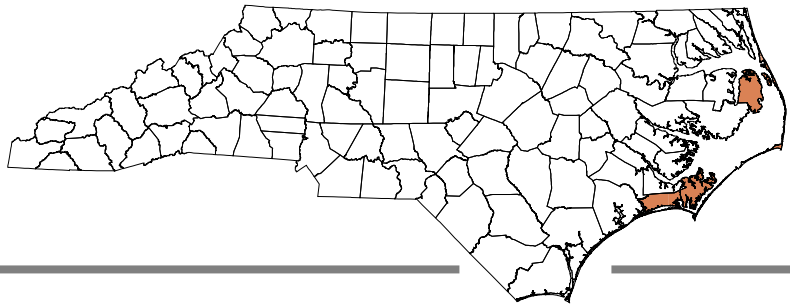
**Management Recommendations:** Protection of habitat of old-growth longleaf pine forests from destruction. Use of prescribed burning to stimulate existing and new longleaf pine communities. Planting of longleaf pine in degraded sites and old fields that are fallow.

** No record has been reported in this county in the past 20 years.*

*Sources: Henry 1989, Hooper et al. 1980, USFWS 1992a, Walters 1990.*

# Roseate tern

*Sterna dougallii dougallii*
Endangered (November 3, 1987)



**Description:** Roseate terns are robin sized, 14-17 inches (35-43 cm) in length including tail. Coloration is white, with a black cap and very pale gray back and wings. This species looks similar to many other terns, however, its beak is usually solid black, its back is paler, and the tail is longer and more deeply forked than in other species. During breeding season it has a rosy tinge on the chest and belly and the basal three-fourths of the black bill and the legs turn orange-red. Call is a loud, harsh "zaap," similar to the tearing of cloth; also a quieter "cue-lick."

**Life History:** Roseate terns feed on small flounder, herring, and mullet caught by plunge diving. They winter in the West Indies and along the northern coast of South America. Breeding grounds are on the Atlantic coast of North America mainly from New York to Nova Scotia, where they arrive in April. Egg laying commences in April and lasts through June. Incubation averages 21 days. Young fledge after about 4 weeks. Nesting takes place in dense grasses on relatively undisturbed coastal islands.

**Habitat:** These migratory birds are rarely seen in North Carolina although they pass through coastal North Carolina from March-May and August-October. Sight records of roseate terns also exist for June, July, and August. They are usually seen off shore along the barrier islands.

**Distribution:** One breeding record has been confirmed for North Carolina. In addition, one to several individuals are reported annually during the breeding season at tern colonies along the North Carolina coast, but these appear to be unmated birds. If this species undergoes range expansion, North Carolina could become a regular nesting site. They have been reported in Carteret* and Dare counties.

**Threats:** Loss of habitat to human disturbance and development, beach stabilization, and erosion.

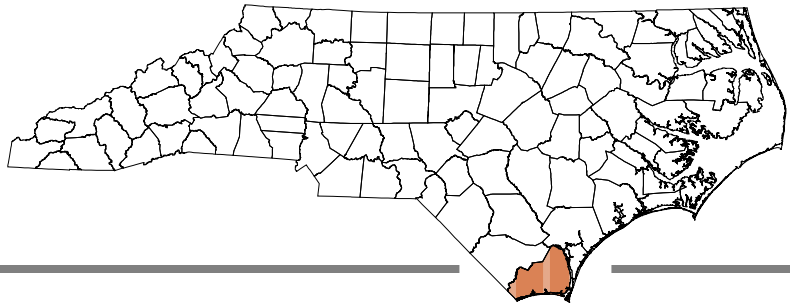
**Management Recommendations:** Protection of barrier islands from beach stabilization, development, and urbanization. Protection of nesting colonies of terns.

* *No record has been reported in this county in the past 20 years.*

*Sources: Bull and Farrand 1977, Lee 1990, USFWS 1998.*

# Wood Stork

*Mycteria americana*
(Wood ibis)
Endangered (February 28, 1984)



**Description:** The wood stork is a large, long-legged wading bird about 3 ft (1.0 m) tall, with a wingspread of 5 ft (1.5 m). The body is white with black flight and tail feathers. The head and neck are largely unfeathered and colored dark gray. The bill is long, stout, slightly curved, and colored black in adults and yellow in immature individuals. During flight, the neck is extended, unlike herons, which fly with their heads tucked close to their bodies. The call is a dull croak.

**Life History:** Wood storks are colonial nesters and feeders and often breed in rookeries with other species of wading birds. Nesting periods vary geographically with nesting generally occurring in spring and early summer. Birds nest in trees with several nests placed in the same tree. Average clutch size is 2-5 eggs with average fledgling rate of 2 young per nest. Storks feed on small fish (1-6 inches long). They have a rather selective foraging ecology capturing prey using a specialized technique known as "grope-feeding" or "tactolocation." Feeding occurs in water 6-10 inches deep using a probing, sweeping sideways motion with the bill partly open. When the bill is touched by a fish, it snaps shut in as little as 25 milliseconds. This manner of feeding requires their prey to be very concentrated as in low water conditions. Droughts and floods alter the concentration of fish in the pools as the water level becomes too low or too high.

**Habitat:** Storks prefer freshwater and brackish wetlands. They forage in the shallow water of ponds, lakes, narrow tidal creeks, flooded tidal pools, and marshes particularly where the water level is dropping and prey are trapped in isolated pools. They frequently nest in cypress and mangrove trees.

**Distribution:** Breeding range extends from South Carolina to Florida along the Atlantic seaboard, parts of Gulf Coast and the Greater Antilles, both coasts of Mexico and South America, and the interior of South America down to Argentina. In the U.S., most nesting populations are located in Florida. Non-nesting individuals have been reported as far north as Canada and inland into the Mississippi Valley and west to California. Most wood stork records in North Carolina are from the Twin Lakes area in southwestern Brunswick County where several dozen individual post-breeding birds are sighted from late June into October. One or two sightings are reported from elsewhere within the state each year, as far inland as the mountains.

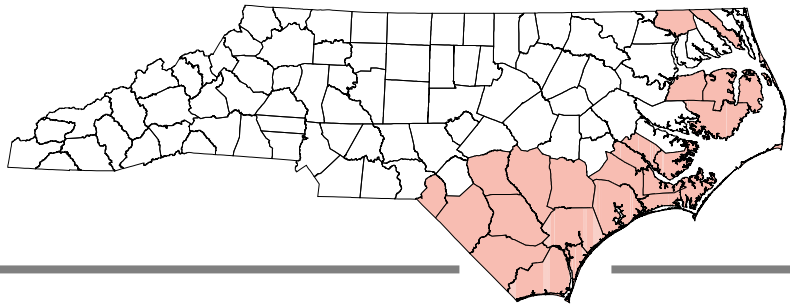
**Threats:** Loss of habitat and alteration of natural hydrological regimes that provide suitable water levels for foraging. Habitat loss is due to extensive logging of bald cypress, wetland drainage and conversion to agriculture, and reduction of food sources due to environmental contamination and unnatural fluctuations of hydrology in foraging areas.

**Recommendations:** Protection of wetland habitats (foraging areas), especially shallow freshwater ponds and swamps.

*Sources: LeGrand 1990, USFWS 1992a, Bull and Farrand 1977.*

# American alligator

*Alligator mississippiensis*
Threatened S/A (June 4, 1987)



**Description:** This large, aquatic reptile is rough backed with a broad rounded snout. Most adults are 6-12 ft (1.8-3.7 m) long with brown to dark brown coloration. The young are marked with yellow bands. Often mistaken for the American crocodile, which has narrower jaw with the fourth tooth exposed while the jaws are closed, the American alligator's fourth tooth fits into a notch in the upper jaw and is not exposed.

**Life History:** Alligators eat anything of a suitable size including mammals, reptiles, amphibians, fish, birds, and crustaceans. Sexual maturity is reached in 10-12 years in the northern part of its range and at approximately 6 ft in length. Nests are constructed near water in late spring and summer. The nests are made from vegetation, debris, and soil mounded to greater than 2 ft high and 6 ft across. Eggs are laid in a cavity near the top of the nest and covered with 6-7 inches of vegetation. Clutch size averages between 35-40 eggs with a maximum of 60. The eggs are usually guarded by the female.

**Habitat:** Slow-moving coastal rivers, canals, lakes, impoundments, marshes, and estuaries. In southern parts of the state, alligators sometimes inhabit cypress ponds in flatwoods and sandhills. Minimum home range for an adult male averages 3100 acres and for an adult female, 21 acres. Tolerance for salinity increases with age.

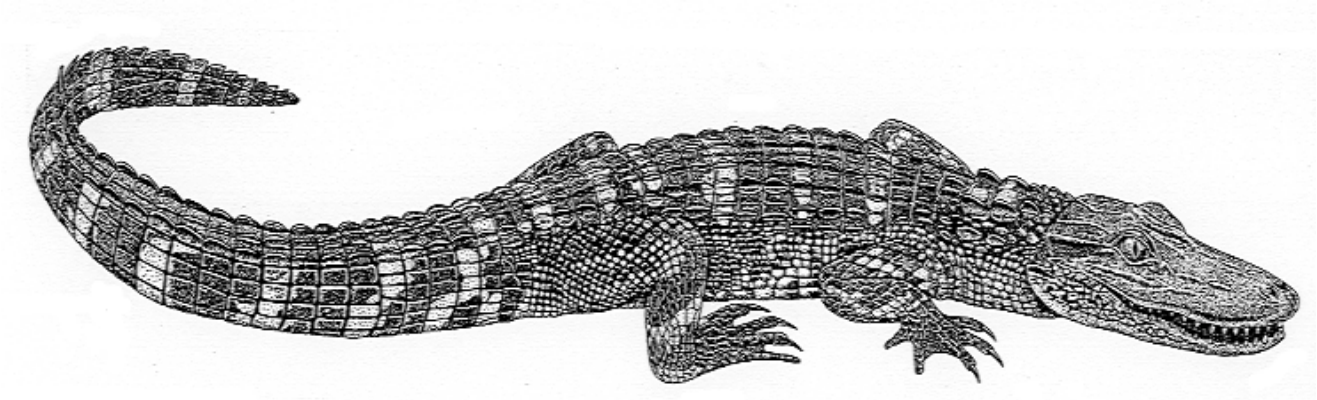
**Distribution:** Alligators range from the southern shore of Albemarle Sound and southward, through the eastern and southern coastal plain. Found in Bladen*, Brunswick, Camden*, Carteret, Columbus, Craven, Cumberland*, Dare, Duplin*, Gates*, Hyde, Jones*, New Hanover, Onslow, Pamlico*, Pender, Robeson, Sampson*, Scotland*, Tyrrell*, and Washington counties.

**Threats:** Threatened due to similarity of appearance to other protected crocodilians. Alligators are no longer biologically threatened or endangered under the Endangered Species Act, but commercial hunting and trade are regulated. Overhunting and illegal poaching in the 1950s and 1960s greatly reduced their numbers. Excessive exploitation and habitat loss also resulted from human encroachment.

**Management Recommendations:** Controlling habitat destruction and exploitation appears to be effective in conserving the species.

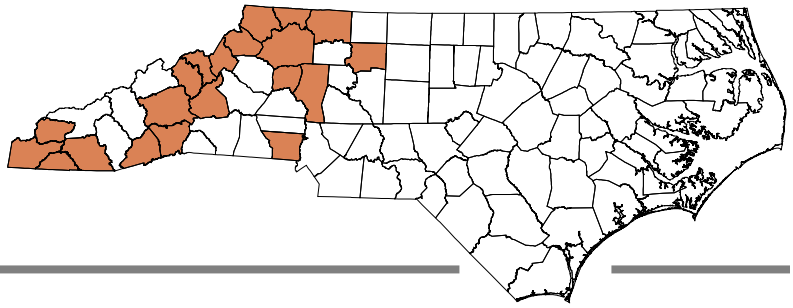
** No record has been reported in this county in the past 20 years.*

*Sources: Martof et al. 1980; Palmer and Braswell 1977, 1995; USFWS 1992a*



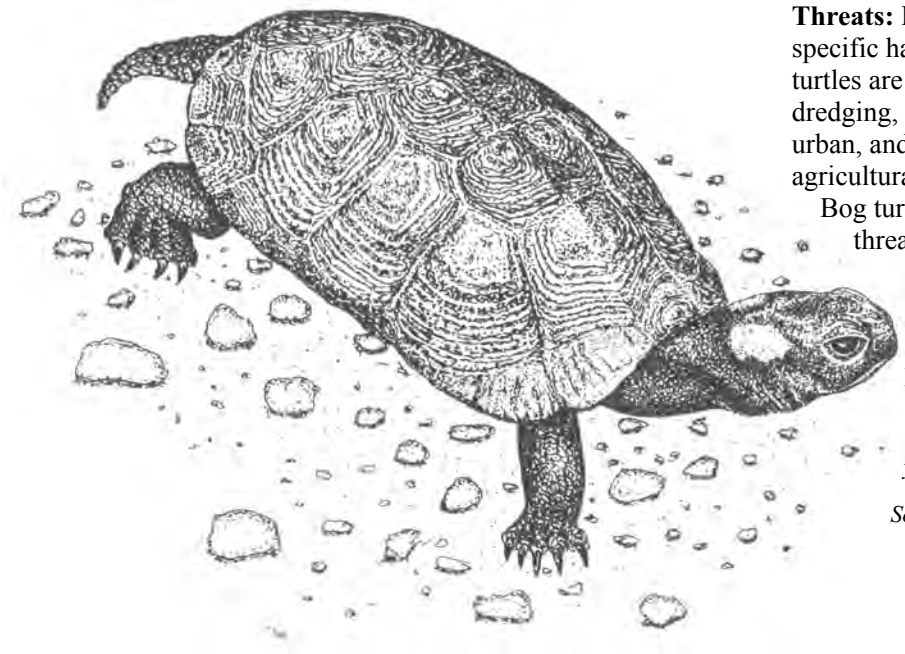
# Bog turtle

Clemmys muhlenbergii
Threatened S/A (November 4, 1997)



**Description:** The bog turtle is a small semiaquatic turtle, usually with a bright orange or yellow blotch on each side of the head. Carapace lengths range from 3-4.5 inches (7.6-11.4 cm). The carapace is elongated, brown to black, often with a low median keel and large scutes with yellowish to reddish centers. It is rough in texture in juveniles but is worn nearly or entirely smooth in old adults, presumably from burrowing into the earth. The hingeless plastron is dark brown to black, usually with yellowish or pale brown mottling. The skin is gray or brown, variously streaked or speckled with red or orange.

**Life History:** Although bog turtles bask on tussocks of grass and clumps of sphagnum, they are generally secretive and burrow into the mud rapidly when disturbed. They may remain buried for extended periods. Bog turtles hibernate from October to April, often just below the upper surface of frozen mud or ice. Natural food consists mostly of insects, but includes earthworms, slugs and other snails, crayfish, carrion, berries, and fleshy seeds (pondweed, sedge, arrow arum). Mating occurs in May and June; eggs are laid in June and July and hatch in August and September. Unlike most other semi-aquatic turtles, bog turtles do not leave their wetland habitat and travel to dry, upland areas to lay eggs. Instead, they select slightly elevated sites, generally on sedge or sphagnum tussocks, for nesting within their marshy habitat. The eggs and hatchlings are preyed upon by various birds and mammals like foxes, raccoons, and opossum.



**Habitat:** The bog turtle inhabits shallow, spring-fed fens, sphagnaceous bogs, marshy meadows and pasture, with thick, grassy cover and crossed by slow, muddy bottomed streams, and swamps with aquatic and semiaquatic plants. The best habitats in NC are open and sunny.

**Distribution:** Bog turtles have been recorded in the northern and southern mountains and in the western and west-central piedmont of North Carolina. Most of the known localities are disjunct and populations are small and localized. Range includes Alexander, Alleghany, Ashe, Avery, Buncombe, Cherokee*, Clay, Davidson, Forsyth, Gaston, Graham, Haywood, Henderson, Iredell*, Macon, McDowell, Mitchell*, Surry, Transylvania, Watauga, Wilkes, and Yancey counties.

**Threats:** Because of their local occurrence and highly specific habitat requirements, many populations of bog turtles are threatened by widespread draining, ditching, dredging, filling, and flooding of wetlands for residential, urban, and commercial development, road construction, agricultural activities, and pond and reservoir construction.

Bog turtles are also highly valued in the pet trade and are threatened by commercial collection.

**Management Recommendations:** Attempts should be made to protect and maintain habitat and prohibit collection.

** No record has been reported in this county in the past 20 years.*

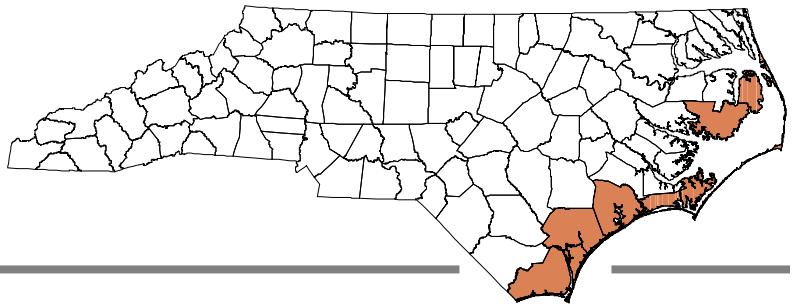
*Sources: USFWS 1997a.*

# General Sea Turtle Information

Sea turtle populations were drastically reduced by hunting in the past. Although hunting has almost been eliminated, sea turtles remain threatened for several reasons. Turtles (and other marine organisms, such as whales) sometimes eat discarded plastic bags and other trash, and may die as a result. They also become entangled in trash and fishing nets, although turtle excluder devices in shrimp nets help reduce accidental drownings. Beach development (sea walls, jetties, lights, off-road vehicles, loud noises, etc.) may confuse females coming to shore to nest. Once the eggs hatch, the hatchlings may become disoriented by artificial lights or be trapped in tire tracks as they head for the sea, leaving them vulnerable to predators. While five species of sea turtles (loggerhead, green, kemp's ridley, leatherback, and hawksbill) have been reported in the waters off the coast of North Carolina, only two are detailed in this volume: the loggerhead sea turtle, which nests in several counties along the coastline, and the green sea turtle, which has been known to come ashore to bask and nest.

# Green sea turtle

*Chelonia mydas*
Threatened (July 28, 1978)

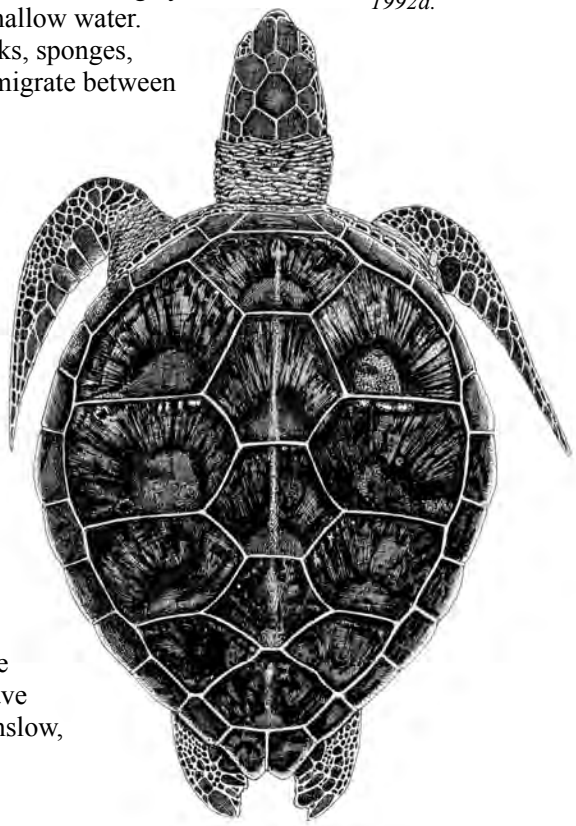


**Description:** The green sea turtle grows to a maximum of 5 ft (1.2 m) long and a weight of 380 lb. It has a rather heart-shaped shell that varies in color from light to dark brown with dark markings. The common name comes from the color of its body fat. The head is small, and in adults it is light brown, marked with yellow. Hatchlings usually have a black carapace, white plastron, and white margins on the shell and limbs. The adult plastron is whitish yellow. None of the plates along the edge of the carapace (the marginal scutes) are jagged, and there is only one long pair of scales between the eyes. Males have one claw on each of the front flippers.

**Life History:** Adult green sea turtles feed largely on marine algae and grasses in shallow water. They also consume small mollusks, sponges, crustaceans, and jellyfish. They migrate between feeding and nesting sites.

**Habitat:** This species is usually seen in shallow bays and inlets. Lagoons and shoals with plentiful marine grasses and algae are important feeding areas.

**Distribution:** Range from Massachusetts to Mexico, Puerto Rico, and the Virgin Islands on the Atlantic coast of North American. Reported seen in Brunswick, Carteret, Dare, Hyde, New Hanover, Onslow, and Pender counties. While they usually visit the entire North Carolina coastline, they have been observed nesting only in Onslow, Brunswick, and Hyde counties.



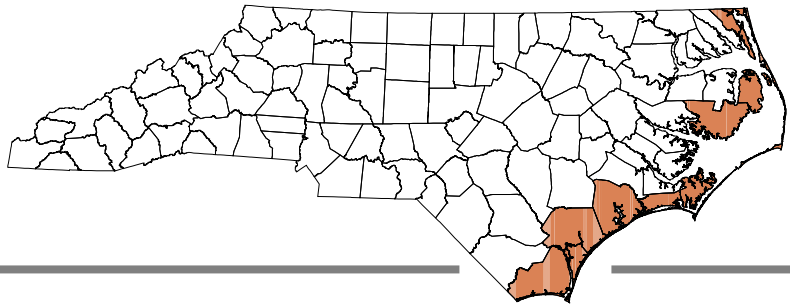
**Threats:** Overutilization as a food source by humans, excessive predation especially of hatchlings (some of the predation is by non-native species, such as pigs), loss of habitat to human encroachment, and drowning after entrapment in fishing nets have all contributed to the decline in populations. Artificial lighting on nesting beaches can result in total disorientation of hatchling turtles so that they never reach the ocean.

**Management Recommendations:** Protection of nesting habitat and use of turtle excluder devices to prevent and reduce incidental capture of sea turtles during shrimp harvest.

*Sources: Martof et al. 1980, Palmer and Braswell 1995, USFWS 1992a.*

# Loggerhead sea turtle

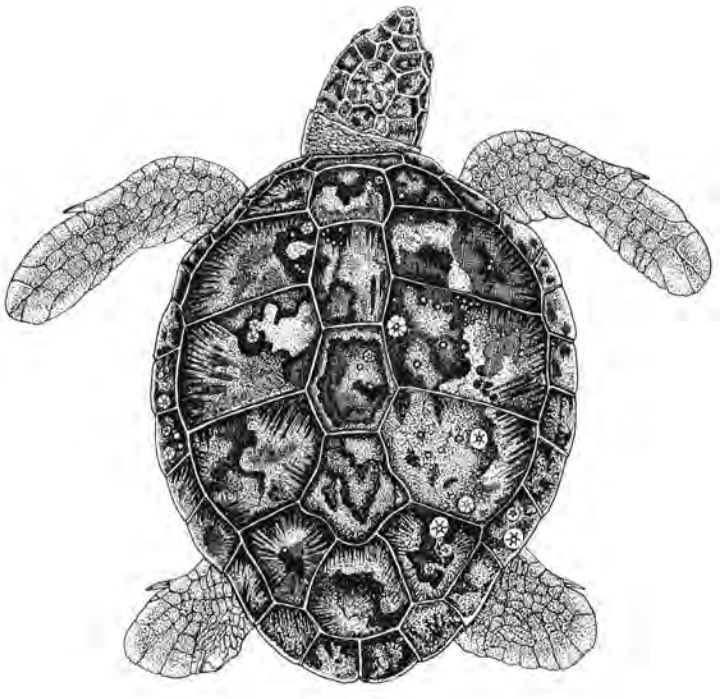
*Caretta caretta*
Threatened (July 28, 1978)



**Description:** The loggerhead is probably the most common sea turtle along North Carolina's coast. The carapace and flippers are reddish brown and the plastron is yellow. It has a large head and blunt jaws (hence its common name). There are three large scales (scutes) on the bridge between the plastron and carapace. The front flippers have two claws each. Adults grow to an average weight of 200 lb.

**Life History:** Loggerhead sea turtles are carnivores. They feed on mollusks, crustaceans, fish, and other marine animals. Nesting occurs on beaches in the United States mostly from May to August, and takes place at night. Hatching usually takes place at night also. The hatchlings head straight for the water once they emerge from the sand, but can be disorientated by beach lights or be trapped in tire tracks in the sand, making them easy prey for predators.

**Habitat:** Loggerheads are found in temperate and subtropical waters both far offshore and in bays, salt marshes, creeks, and mouths of large rivers. Reefs and shipwrecks are frequently used as feeding places. Hatchlings have been seen at sea in patches of sargassum (a floating, offshore algae). Nesting usually takes place on open beaches, or along narrow bays with suitable soil, and usually occurs no further north than Ocracoke Inlet. They will migrate as far as 1500 miles between nesting sites and feeding areas**.**



**Distribution:** Entire coastline of North Carolina including Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, and Pender counties.

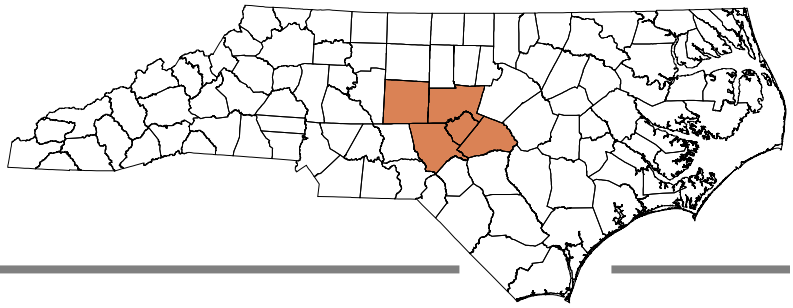
**Threats:** Loss of nesting beaches to various types of human encroachment, especially beach "armoring" against erosion (riprap, seawalls, etc.). Other threats include artificial lighting that disorients hatchlings, drowning from entrapment in fishing nets and internal injury due to ingestion of marine pollution including oil, plastics, and Styrofoam.

**Management Recommendations:** The National Marine Fisheries Service is implementing regulations requiring the use of turtle excluder devices by shrimp trawlers. Light ordinances and protection of nesting sites from vehicular traffic during the nesting season are effectively reducing mortality on many beaches. Control of predation with nest-screening is also helping in areas with unnaturally dense populations of raccoon or feral animals.

*Sources: Martof et al. 1980, Palmer and Braswell 1995, Schwartz 1977d, USFWS 1992a.*

# Cape Fear shiner

*Notropis mekistocholas*
Endangered (September 26, 1987)



**Description:** The Cape Fear shiner is a small minnow, rarely exceeding 2.4 inches (6 cm) in length. It is a pale silvery yellow with a black stripe along each side. The fins are yellow and pointed, the upper lip is black, and the lower lip has a thin black bar along its edge.

**Life History:** Unlike other members of the genus *Notropis*, the Cape Fear shiner feeds extensively on plant material and so has an elongated, convoluted intestine. No information is available on its breeding behavior or longevity. Although poorly known, spawning apparently occurs in late spring and early summer based on breeding tubercles and ovarian development of museum specimens.

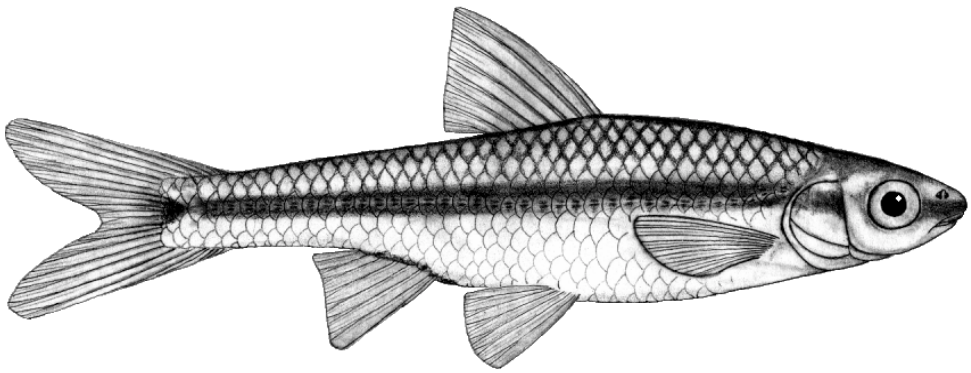
**Habitat:** Water willow, (*Justicia americana*), beds in flowing areas of creeks and rivers appear to be an essential element of the species' habitat. It is found in clean, rocky streams over gravel, cobble, and boulder substrate; known to inhabit pools, riffles, and slow runs. Juveniles are often found in slack water, among mid-stream rock outcrops, and in side channels and pools.

**Distribution:** Endemic to central North Carolina in the Cape Fear drainage. This species has the most restricted distribution of any *Notropis* shiner. It is currently known from the Deep River and Rocky River within several miles of their confluence (this is the main population), in the Rocky River above the Rocky River hydroelectric dam, as well as Robseson Creek and Bear Creek in the Rocky River system; in the Deep River system above the Highfalls Hydroelectric Reservoir, and in the lower Haw River just above Jordan Lake. It is also found a short distance up tributaries to these rivers. It was formerly found in several tributaries to the Cape Fear River in Harnett County. Three areas in North Carolina have been designated critical habitat for the Cape Fear shiner. They are in Chatham, Harnett, Lee, Moore, and Randolph counties.

**Threats:** Deterioration of water quality due to toxic chemical pollution, changes in stream flow, channel modification, siltation, and impoundments.

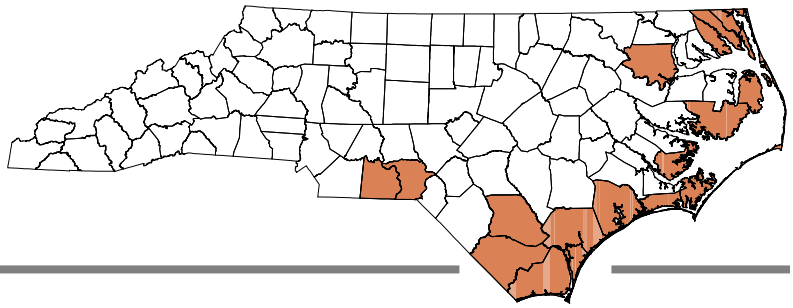
**Management Recommendations:** Enforcement of regulations to prevent erosion from road construction and land use changes, stream channel modification, changes to stream flow for hydroelectric power plants, impoundments, and wastewater and chemical discharges.

*Sources: Lee et al. 1980, Lowe et al. 1990, USFWS 1992a.*



# Shortnose sturgeon

*Acipenser brevirostrum*
Endangered (March 11, 1967)



**Description:** The shortnose sturgeon has five rows of bony plates, or scutes, (1 dorsal, 2 lateral, and 2 ventral) separated by naked skin that runs the length of the body, a tail with the upper lobe larger and longer than the lower, and four barbels (like droopy whiskers) along the mouth located under a long pointed snout. This sturgeon has a blackish head and back, yellowish-brown body, pale underside, and grows to about 39 inches (1 m) long. Young individuals have blotches of darker color. The shortnose sturgeon resembles young Atlantic sturgeon (*A. oxyrhynchus*), but can be distinguished by its shorter snout, wider mouth (mouth width greater than 62% of distance between eyes), and the usual lack of bony plates between the anal fin base and the lateral row of plates.

**Life History:** This fish moves from the ocean and estuaries into freshwater rivers between February and May, and spawns from April through June. Juveniles may remain upriver for up to 5 years after birth before migrating to the ocean. Feeds on worms, crustaceans, insect larvae, small clams, small fish, and stems and leaves of macrophytes. It matures at 4-16 years of age and may live for up to 60 years.

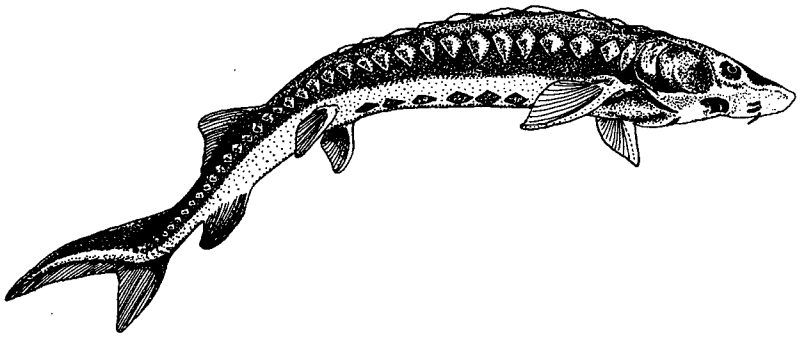
**Habitat:** A bottom dweller, shortnose sturgeon prefer deep water with soft substrate and vegetated bottoms. Found in ocean and estuaries, at spawning requires freshwater of inland portions of rivers with fast current and rough bottoms. According to Jackson et al. (1992), the fish usually gather in deep spots during the day and move to tidal flats for the night, in the summer and early fall.

**Distribution:** This fish is found along the Atlantic coast from New Brunswick to Florida. Historically, shortnose sturgeon were widely reported from North Carolina rivers. Current distribution is not well known. This species occurs sparingly in the Cape Fear River drainage and Albemarle Sound, and an unconfirmed report exists for Pamlico Sound. Most recent reports have come from the Cape Fear River near Wilmington. Also, it has been found in the Pee Dee River and in the Roanoke River not far from the river's mouth. Records exist for Anson, Bertie, Bladen, Brunswick, Carteret, Columbus, Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, and Richmond counties.

**Threats:** Overfishing and degradation of habitat by erosion, siltation, toxic pollution, and dams that interfere with upstream migration to spawning areas.

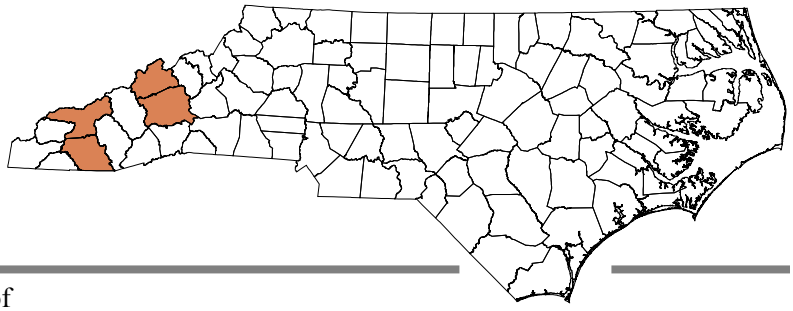
**Management Recommendations:** Enforcement of protective laws regarding fishing and water quality regulation.

*Sources: Gilbert and Moran 1989, Jackson et al.1992, Lee et al. 1980, Ross 1988.*



# Spotfin chub

*Cyprinella monacha*
Threatened (September 9, 1977)



**Description:** This small fish grows to a maximum size of about 3.7 inches (9.2 cm) standard length. The body is elongate; the mouth inferior; usually there is one pair of minute, terminal labial barbels (like a short droopy whisker); the scales are moderate to somewhat small in size; a distinctive large black spot is present in the caudal region. Juveniles and adult females are olive above with the sides largely silvery and the lower parts white. Large nuptial males have brilliant turquoise-royal blue coloring on the back, side of the head, and along the mid-lateral part of the body; lesser blue is found in at least some fins; all fins are tipped with satiny white during peak development of color.

**Life History:** Based on observations and morphological comparisons, it appears that the spotfin chub is a sight feeder, selecting minute insect larvae from clean substrates. An examination of nine specimens revealed that diptera were the dominant food items, with the remaining food items consisting of immature mayflies, stoneflies, and caddisflies. Its maximum life span is suspected to be less than 4 years. Spawning begins in May and extends into mid-August. They lay their eggs in boulder crevices (where they are highly vulnerable to the effects of siltation, as well as other polluntants).

**Habitat:** The spotfin chub inhabits moderate to large streams 50-230 feet (15-70 meters) wide with a good current, clear water, and cool to warm temperatures. These streams have pools frequently alternating with riffles. The fish generally occupies areas with moderate to swift current with a wide variety of substrates, although rarely, over sand or silt substrates.

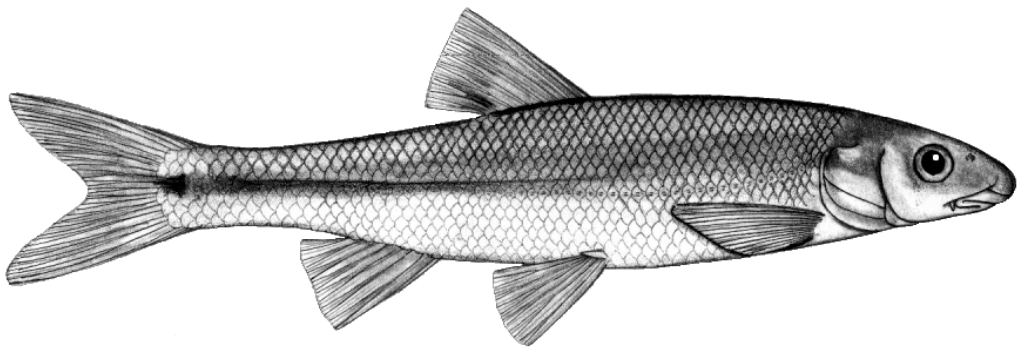
**Distribution:** This once widspread species was historically known from 24 streams in the upper and middle Tennessee River system. It is now extant in only four rivers/river systems: the Buffalo River system in central Tennessee, the Emory River system in eastern Tennessee, the Holston River and its tributary, the North Fork Holston River, in northeastern Tennessee, and the Little Tenness River in Swain and Macon counties in North Carolina. Formerly found in the French Broad River system in North Carolina. Found in Buncombe*, Macon, Madison*, and Swain counties.

**Threats:** The reasons for the decline in some populations are uncertain. However, most populations have been impacted by a number of factors (e.g., dams, runoff from coal mining operations and poor land use practices, municipal and industrial wastes).

**Management Recommendations:** Protect extant populations by enforcing existing natural resource protection laws and regulations. Improve habitat of extant populations and restore habitat of historical populations. Gain a better understanding of the species life history and habitat needs. Reintroduce populations into restored historical habitats.

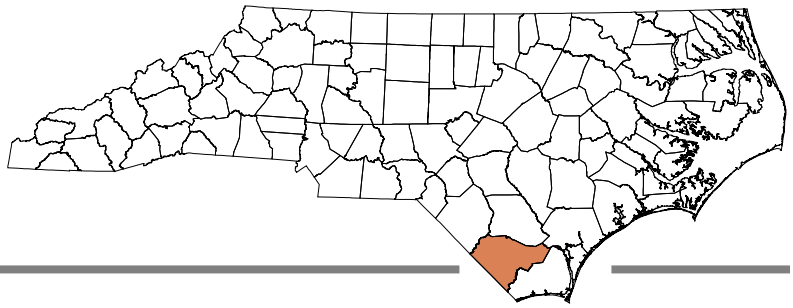
** No record has been reported in this county in the past 20 years.*

*Sources: Biggins and Fridell pers. com., Cooper et al. 1977, Jenkins, et al. 1984, USFWS 1983, USFWS 1992a.*



# Waccamaw silverside

*Menidia extensa*
(Skip jack, glass minnow)
Threatened (April 8, 1987)



**Description:** The Waccamaw silverside is a small, almost transparent minnow-like fish with a silver lateral stripe. Adults are about 2.5 inches (6.5 cm) long. It is laterally compressed with large eyes and a jaw that angles upward sharply. There are two widely separated dorsal fins; the first has thin spines. It may often be seen jumping out of the water.

**Life History:** This species is a surface-feeder and travels in schools. Food sources include zooplankton, particularly cladocerans (microcrustaceans). Spawning occurs in open water near the shoreline from March through July, peaking when water temperatures are 68-72°F. Females produce about 150 eggs. Maturity is attained by the following spring when most adults die off after spawning. A few may survive a second winter. Reproductive failure for a single year could result in the species' extinction.

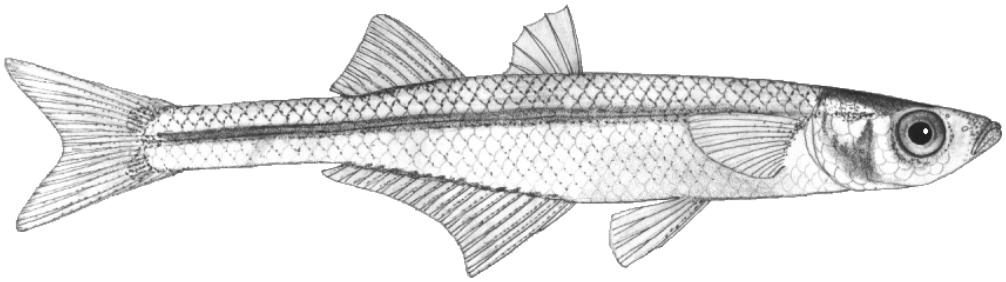
**Habitat:** Forages in areas of shallow, high quality clear, open water over clean, dark sand substrate with no vegetation.

**Distribution:** Endemic to Lake Waccamaw, Columbus County and occasionally the upper Waccamaw River (below the lake) when water is high. This limited range has been designated critical habitat by the U.S. Fish and Wildlife Service. Lake Waccamaw is a natural lake fed by acidic swamp streams. However, the neutral composition of the water may be a result of calcareous limestone, that underlies the lake and is exposed on the north shore. The silverside inhabits open water throughout the lake, schooling near the surface over shallow, dark bottom areas.

**Threats:** Indiscriminate logging, land use changes such as stream channelizing and bridge and road construction, chemical pollution from pesticides and herbicides, and wastewater discharge. These produce siltation and change water quality, temperature, and nutrient enrichment which threaten spawning success and increase odds for extinction due to the short life span and restricted global distribution.

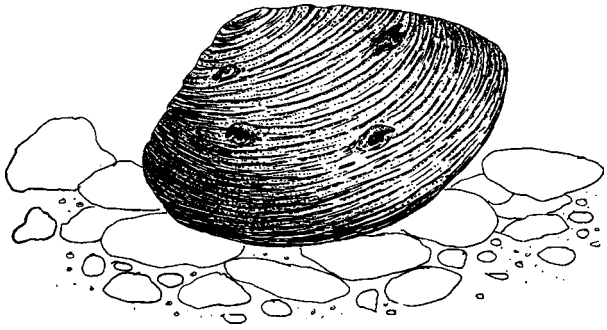
**Management Recommendations:** Monitoring and control of water quality by regulating land and natural resource use and development in the area.

*Sources: Cooper et al. 1977, Lowe et al. 1990, Mignogno pers. com., USFWS 1992a.*



# Mollusks: Freshwater Bivalves

## An Overview of Freshwater Mussels



The freshwater mussel could be described as the "canary" of the aquatic world. As the canary in the underground mines of historical times was the early-warning system that notified miners of dangerous air pollution and lack of oxygen, so the status of a mussel population is an indicator of the water quality in the aquatic system that is its habitat. Because mussels require clean water to survive, the reduction and extirpation of these species in a lake or stream constitute a warning that water quality has been lowered and may be potentially hazardous for other species including humans.

**Description:** The freshwater bivalved mollusks have two valves (shells) joined together at the dorsal surface by a hinge ligament and by two strong internal muscles. The valves, which remain slightly open, are secreted by a thin layer of tissue called the mantle, which also forms **incurrent** and **excurrent** openings (siphons) at the posterior end of the animal. The anterior end is usually buried in the substrate.

All mussels are filter feeders. With its anterior buried in the bottom, the naiad draws oxygen-bearing water and food through the incurrent siphon, and passes deoxygenated waste-carrying water out the excurrent siphon. Food (mostly detritus, bacteria, one-celled algae, and small planktonic organisms) is filtered from the water by the gills. Through these filter-feeding activities, the mussels serve as a biological filter by removing organic and inorganic particles from the water, thus improving water quality downstream. This filtering activity also puts these species at risk from pollutants entering the streams.

The identification of freshwater mussel species relies primarily on shell characteristics. The most important diagnostic features are shape and dimensions of the shell, sculpture of the beak and surface, and coloration of the epidermis and nacre. Because of polymorphic shell characteristics in some species, it is difficult, even for experts, to determine differences between species, and sometimes between individuals in the same population. Therefore, only biologists with permits are allowed to complete surveys for these species. Illustrations are not included here, but the interested reader may consult a state maintained Web site for more information about these species (*http://www.wildlife.state.nc.us/nongame/mussel/*).

**Life History:** Naiad females extrude eggs through their oviducts and move them into the water tubes of the gills. During this period, the water tubes become more or less modified as gill pouches, forming a marsupium. Sperm shed by the males are drawn into the marsupial water tubes by ciliary action, and the fertilized eggs begin developing into unique larval forms known as **glochidia**. Depending on the genus, either all or only a portion of the gills may carry the developing embryos. A single female may produce hundreds of thousands of embryos. Short-term brooders spawn in spring and release glochidia in the summer while long-term brooders spawn in late summer, hold the glochidia through the winter, and release them in the spring and early summer.

The bivalved glochidium lacks most of the internal organs of the adult and is not capable of swimming or crawling. Almost all appear to be obligate parasites of fish. Most are parasitic on the gill filaments, skin, or fins of the fish. The infections are usually light and produce little harm. A major function of this parasitic relationship is to serve as a means of dispersal, transporting the juveniles some distance from their parental source. Specificity to particular host fishes limits the ability of the glochidia to reach maturity if that host is not available. Part of the plan for preserving threatened and endangered naiads, therefore, should be the preservation of native fish fauna and their natural migration and spawning patterns.

Of all the freshwater invertebrates, the freshwater mussels probably have the longest natural life span. Some thin-shelled pond species live only 4-10 years, but thicker shelled river species may survive several decades. While sexual maturity may require from 1-4 years, reproductive capability continues until the end of life.

While river naiads can be found as isolated specimens, they are most often found clustered in large groups called **beds**. These units are far more important reproductively than single individuals and are vital to perpetuating a population. Often, a single bed may be the source for an entire stream population, and destruction of such may result in extirpation of the species from the area.

**Habitat:** Some species of mussels are found in both streams

and lakes, while others are restricted to one habitat. Species specific to streams cannot survive in lakes, mostly because of the lack of proper glochidia fish hosts and /or because of the lack of currents that provide an adequate supply of food and oxygen. The preferred habitat varies with the species; but most riverine species do best in a cobble, gravel-sand substrate with good current and high water quality. Little movement occurs unless forced by environmental conditions. An individual rarely moves more than a few hundred yards in a lifetime. The range of any one species may be limited to a single river system.

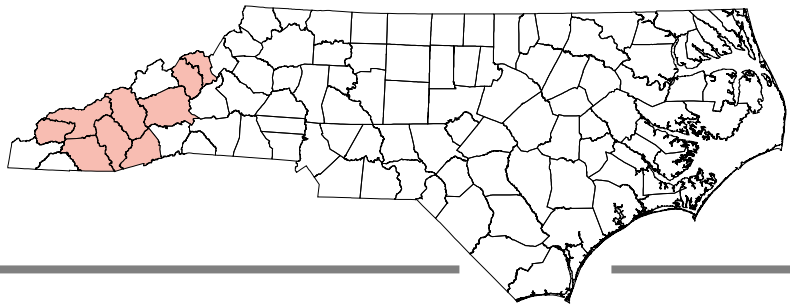
**Threats:** The decline of mussels in North Carolina is caused by the degradation and destruction of instream habitat including altered natural fish communities. Detrimental to the aquatic environment are activities such as impoundment, channelization, and dredging, which cause deadly amounts of siltation as well as fragmentation of habitat. Riparian habitat is disturbed as a result of cutting and clearing of vegetation along stream banks, bank destabilization, and residential and road construction. These produce erosion, siltation, and sedimentation. Changes in water temperature, lowering of oxygen levels, and reduction of water quality results from wastewater discharges, toxic spills, pesticide and herbicide runoff, and the introduction of other pollutants. The smothering action of siltation seems to be the most detrimental factor.

**Management Recommendations:** Protection of water quality and existing habitat, and restoration of degraded habitat. Enforcement of protective laws so that potential threats to specific sites can be identified and preventive measures taken. Education of the public of the environmental threats to the mussels and the important role they play in aquatic ecosystems.

*Sources: Terwilliger et al 1995, USFWS 1990.*

# Appalachian elktoe

*Alasmidonta raveneliana*
Endangered (November 23, 1994)



**Description:** The Appalachian elktoe has a thin, kidney-shaped shell, reaching up to about 4 inches in length. Juveniles generally have a yellowish-brown outer shell, while the shell of the adults is usually dark brown to greenish-black in color. Rays are prominent on some shells, particularly in the posterior portion of the shell, but some individuals have only obscure greenish rays. The inside shell surface is shiny, white to bluish-white but changing to a salmon, pinkish, or brownish color in the central and beak cavities of the shell.

**Life History:** Feeds by filtering food particles from the water column. Specific food habits are unknown but assumed to be same as other mussels: detritus, one-celled algae, and plankton. The reproductive system is similar to other mussels with glochidia parasitizing a fish host. The mottled sculpin (*Cottus bairdi*) and banded sculpin (*Cottus carolinae*) have been identified as hosts for the species. The mussel's life span and many other aspects of its life history are unknown.

**Habitat:** Has been reported from relatively shallow, medium-sized creeks and rivers with cool, well-oxygenated, moderate- to fast-flowing water. Observed in gravelly substrates often mixed with cobble and boulders, in cracks in bedrock, and sometimes in relatively silt-free, coarse, sandy substrates.

**Distribution:** Endemic to the upper Tennessee River system in western North Carolina and eastern Tennessee. It once had a fairly wide distribution but has been extirpated from hte majority of its historic range including the French Broad River, Swannanoa River; and Talula Creek in the Little Tennessee River Basin. It now occurs in short stretches of the Little Tennessee River in Swain and Macon counties, Tuckasegee River in Jackson and Swain counties, Pigeon River in Haywood County, Little River in Transylvania County, Cheoah River in Graham County, Cane River in Yancey County, and the Nolichuchy, North Toe, and Toe Rivers in Yancey and Mitchell counties.

**Threats:** Water quality and habitat degradation resulting from impoundments, stream channelization projects, and point and nonpoint sources of siltation and other pollutants appear to be major factors in reducing the species' distribution and reproductive capacity. The most immediate threats to remaining populations of the species currently appear to be associated with sedimentation and other pollutants (fertilizers, pesticides, heavy metals, oil, salts, organic wastes) from nonpoint sources.

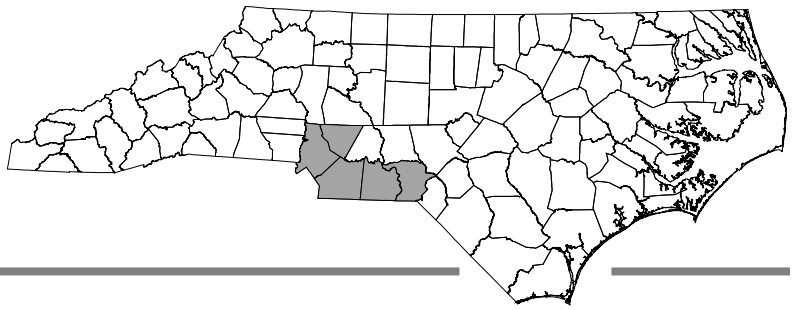
**Management Recommendations:** Protection of existing water and habitat quality of the reaches of the river systems where the species is still surviving; improve degraded portions of the species habitat; reestablish and protect additional populations of the species within portions of its historical range. This requires compliance with existing state and federal regulations by the public, local governments, and industries. Additional research is also needed on the autecology of the species, propagation, and reintroduction techniques for freshwater mussels.

*Sources: USFWS 1994a, 1996a., **WRC website***

**Species identification key is available at www.ncwildlife.org.** (Click on "Wildlife Species and Conservation" and then "Species" for Mussel atlas.)

# Carolina heelsplitter

*Lasmigona decorata*
Endangered (May 30, 1993)



**Description:** This bivalve may be more than 4.5 inches (11.4 cm) long as an adult. The shell has an ovate, trapezoid shape. The shell varies in color from greenish brown to dark brown. Younger individuals have fine rays (stripes radiating outward from the hinge area) on the outer shell, which are greenish brown or black. The inner shell varies from pearly white to bluish white, becoming orange toward the hinge area. Older individuals may be entirely orange on the inner surface. There is a projection between the pseudocardinal teeth and the lateral teeth in the left valve, but it may be small and fused to the pseudocardinal tooth. The entire outer sections of the gill are used by the female to carry embryos. The Carolina heelsplitter is similar in appearance to *L. subviridis*, but has a thicker shell and adults can be over twice as large.

**Life History:** Because of its rarity, little is known of the life span and other aspects of the life history of the Carolina heelsplitter. Like other freshwater mussels, it is a filter-feeder. It has a complex reproductive cycle in which the mussel larvae parasitize a host fish -- an as yet unknown species.

**Habitat:** Usually found in mud, muddy sand, or muddy gravel substrate in cool, slow-moving, small to medium-sized streams or rivers along stable, well-shaded streambanks. The stability of the stream banks appears to be a very important factor in the habitat.

**Distribution:** In North Carolina is known only from Goose, Duck, and Waxhaw Creeks in Union County. Portions of these three creeks in North Carolina and six creeks and one river have been proposed for designation as critical habitat for the Carolina heelsplitter. Historically known from several locations within the Catawba and Pee Dee River systems in Anson*, Cabarrus*, Mecklenburg*, and Richmond* counties in North Carolina, and the Catawba, Pee Dee, Savannah, and possibly the Saluda River systems in South Carolina.

**Threats:** The range has been drastically reduced by impoundments and deterioration of habitat and water quality by siltation and other pollution resulting from stream channelization, dredging, sand mining, sewage effluents, and poorly implemented agricultural, forestry, and development practices. Loss of forested buffers and poorly controlled stormwater runoff from clearing and development activities within the creeks' watersheds, together with the effects of pollutants in wastewater discharges have significantly reduced the range of the surviving populations in North Carolina. Due to limited range, any further adverse impact of habitat or water quality in the remaining stream reaches would likely lead to extirpation of the species from North Carolina.

**Management Recommendations:** Preservation of habitat in existing reaches and restoration of high water quality and habitat in historical range waterways.

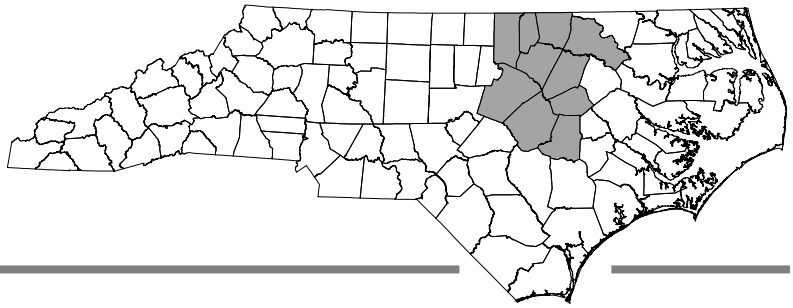
**No record has been reported in this county in the past 20 years.*

*Sources: Alderman 1991, Fridell 1992, Fridell and Biggins pers. com., Keferl and Shelley 1988, USFWS 1993a.*

**Species identification key is available at www.ncwildlife.org.** (Click on "Wildlife Species and Conservation" and then "Species" for Mussel atlas.)

# Dwarf wedgemussel

*Alasmidonta heterodon*
Endangered (March 14, 1990)



**Description:** The dwarf wedgemussel is a small bivalve, rarely exceeding 45 mm in length. Clean young shells are usually greenish-brown with green rays. As the animal ages, the shell color becomes obscured by diatoms or mineral deposits and appears black or brown. The shell is thin but does thicken somewhat with age, especially toward the anterior end. The anterior end is rounded while the posterior end is angular forming a point near the posterio-ventral margin. The ventral margin is only slightly curved. The nacre is bluish-white, appearing whiter in the thicker anterior end. The most distinctive shell character of the dwarf wedgemussel is the arrangement of the lateral teeth. There are two lateral teeth in the right valve and one in the left valve. The typical arrangement for most freshwater mussel species consists of two lateral teeth in the left valve and one in the right valve. The incurrent and excurrent apertures and their associated papillae are usually white. The foot and other organs are also white.

**Life History:** Maximum age for the dwarf wedgemussel is around twelve years. The species is a bradytictic breeder. Females become gravid in the early fall and glochidia are released by mid-spring. The tessellated darter (Etheostoma olmstedi), johnny darter (Etheostoma nigrum), and mottled sulpin (Cottus bairdi) have been identified as hosts for the dwarf wedgemussel. An anadromous fish may also serve as a host species but this has not been documented for the dwarf wedgemussel in the southern portion of its range.

**Habitat:** Inhabits creeks and rivers close to banks, under overhangs, and around submerged logs. Also known to live on firm substrate of sand, gravel, and muddy sand with a slow to moderate current. Requires clean water that is well-oxygenated and nearly silt free.

**Distribution:** Atlantic slope rivers and creeks from New Brunswick, Canada to the Neuse River system, North Carolina. North Carolina supports the greatest number of known sites: Neuse River Basin: Orange County, Wake County, Johnston County, Wilson County, and Nash County; Tar River Basin: Person County, Granville County, Vance County, Franklin County, Warren County, Halifax County, and Nash County. Unfortunately, most of these populations are very small and isolated.

**Threats:** Construction of impoundments and pollution from industrial, agricultural, and domestic sources has degraded the habitat and water quality.

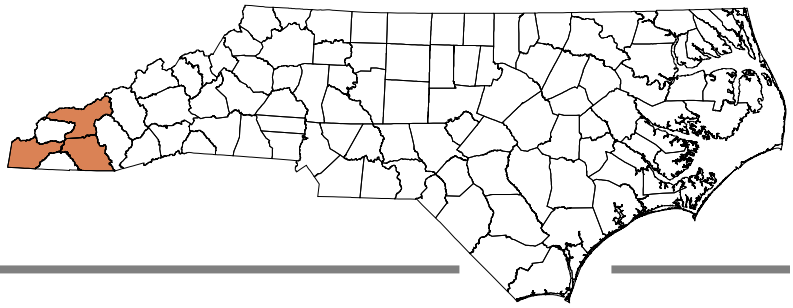
**Management Recommendations:** Preservation and restoration of high water quality and habitat. Vegetative buffer strips, conservation easements, and development of mussel sanctuaries are suggested recovery methods. Research of ecology and life history as well as identification of species of fish host(s) is needed.

*Sources: Hall pers. com.; Mignogno pers. com; USFWS 1990, 1994b., WRC website*

**Species identification key is available at www.ncwildlife.org.** (Click on “Wildlife Species and Conservation” and then “Species” for Mussel atlas.)

# Littlewing pearlymussel

*Pegias fabula*
Endangered (November 14, 1988)



**Description:** The littlewing pearlymussel is small, rarely exceeding 1.5 inches (38 mm) in length. The shell's outer surface (periostracum) is usually eroded, giving the shell a chalky appearance. When the periostracum is present, the shell is light green or dark yellowish with dark rays. The shells exhibit sexual dimorphism; females have an inflated posterior ridge and a more truncated posterior end.

**Life History:** Much of the species' life history is unknown. However, it is thought to be a winter breeder and reproduce like other freshwater mussels. Males release sperm into the water, which are taken in by females through their siphons during feeding and respiration. The fertilized eggs are retained in the gills until the larvae (glochidia) are fully developed. The glochidia are released into the water and must then attach and encyst on a fish host's gill or fin. Here they transform into juvenile mussels and then drop off onto the stream bed. Greenside darters (*Etheostoma blennioides*) and emerald darters (*E. baileyi*) have been identified as host fish. The mussels specific food habits are unknown. However, adults are filter feeders and likely ingest food items similar to those consumed by other freshwater mussels (i.e., organic detritus, diatoms, phytoplankton, zooplankton, bacteria).

**Habitat:** It inhabits cool, clear, and relatively high gradient streams (of small to medium size) where it is sometimes found lying on a rocky stream bed in shallow water. However, it is more often hidden under large rocks.

**Distribution:** This once wide ranging species once inhabited numerous smaller tributaries of the upper Cumberland and Tennessee River basins in Alabama, North Carolina (Little Tennessee River, Swain County and Valley River, Cherokee County), Kentucky, Tennessee and Virginia. Currently, three populations may still survive in the Cumberland River system and three in the Tennessee River system, including a very small population in the Little Tennessee River, North Carolina.

**Threats:** The reasons for the decline in some populations are uncertain. However, most populations have been impacted by a number of factors (e.g., dams, runoff from coal mining operations and poor land use practices, municipal and industrial wastes, dredging).

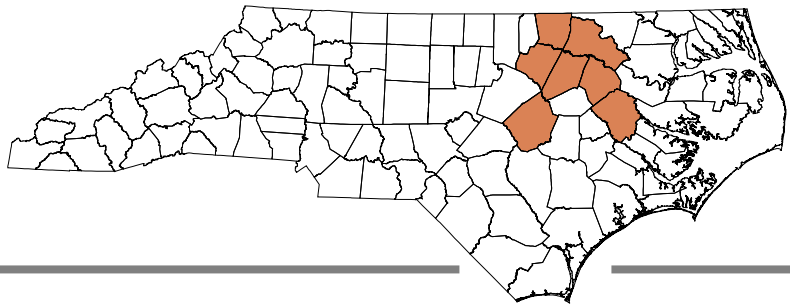
**Management Recommendations:** Protect extant populations by enforcing existing natural resource protection laws and regulations. Improve habitat of extant populations and restore habitat of historical populations.

*Sources: Bogan et al. 1983.*

**Species identification key is available at www.ncwildlife.org.** (Click on "Wildlife Species and Conservation" and then "Species" for Mussel atlas.)

# Tar spinymussel

*Elliptio steinstansana*
(Tar River spinymussel)
Endangered (June 27, 1985)



**Description:** The Tar spinymussel is one of only four freshwater mussels with spines in the world. The brownish shell is rhomboid-shaped, up to 2.4 inches (6 cm) long, with 0-6 spines on each valve. The shell is rather smooth and shiny, with concentric rings, and ends in a blunt point. Younger individuals are orange-brown with greenish rays streaking outward from the hinge area. Adults are darker with less distinct rays. One to three small thin ridges run on the interior surface of the shell from the beak cavity to the lower ventral area of the shell. The anterior half of the shell's inner surface is salmon-colored, the posterior half is iridescent blue. Juveniles may have up to 12 spines, however, adults tend to loose their spines as they mature.

**Life History:** Little is known about the life history except that like most freshwater mussels, they are filter feeders and require a fish host to complete their reproductive cycle.

**Habitat:** Stable, coarse sand or gravel substrates where the gravel is uncompacted and silt free and in areas of relatively fast-flowing, well-oxygenated water. They are often found in association with other mussels but are usually in the minority.

**Distribution:** Known only from the Tar River system (Tar River, Shocco Creek, Fishing Creek, Little Fishing Creek, and Swift Creek) in Edgecombe, Franklin, Halifax, Nash, Pitt*, and Warren counties, and one site in the Neuse River system in Johnston County. The species has been reduced from "relatively easily found" in the main stem of the Tar River in Edgecombe County to "only two good populations . . . in the two Tar River tribs . . . found with great difficulty in two other trib and in the main stem of the Tar River. . . ." (USFWS 1994f).

**Threats:** Degradation of habitat and water quality by impoundment and pollution. Part of the Tar River has been dammed. Clearing of land for agriculture and other uses in the Tar River basin has caused erosion and siltation into the river. The sand and silt smother the mussels and affect the stability of the river bottom. Pollution from 21 wastewater plants and discharges from agricultural, industrial, and other domestic sources have drastically altered the river reaches and tribs. Mussels that evolved in clean, flowing water are unable to survive and reproduce in this degraded habitat.

**Management Recommendations:** Buffering riparian areas along waterways with natural vegetation strips to help filter silty runoff from disturbed lands. Prevention of livestock and waste from entering rivers and tribs. Improved erosion prevention and more stringent enforcement of pollution laws for industrial and municipal wastewater facilities.

** No record has been reported in this county in the past 20 years.*

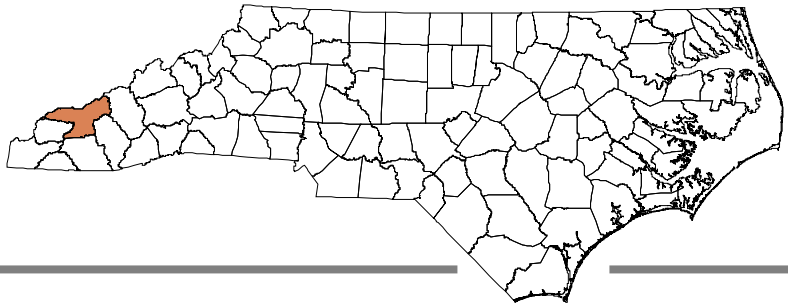
*Sources: Biggins and Fridell pers. com.; Lowe et al.1990; Murdock pers. com.; USFWS 1992c, 1994f.*

**Species identification key is available at www.ncwildlife.org.** (Click on "Wildlife Species and Conservation" and then "Species" for Mussel atlas.)

# Mollusks: Terrestrial Gastropods

# Noonday globe (snail)

*Patera clarki nantahala*
(Noonday helix)
Threatened (July 3, 1978)



**Description:** The shell of the noonday globe snail is rounded with five and one-half spirals. The spire (center) of shell is rounded and low, or may be depressed. The shell is 0.72 inch (18 mm) wide and 0.44 inch (11 mm) high, and is glossy brownish-yellow, or red. Coarse bands texture the shell. It is most active during wet weather, and is thought to feed on fungi.

**Life History:** The feeding habits and development cycle of this species are unknown. However, other related species in the genus *Mesodon* feed on the subsurface hair-like structures (mycelia) of fungi.

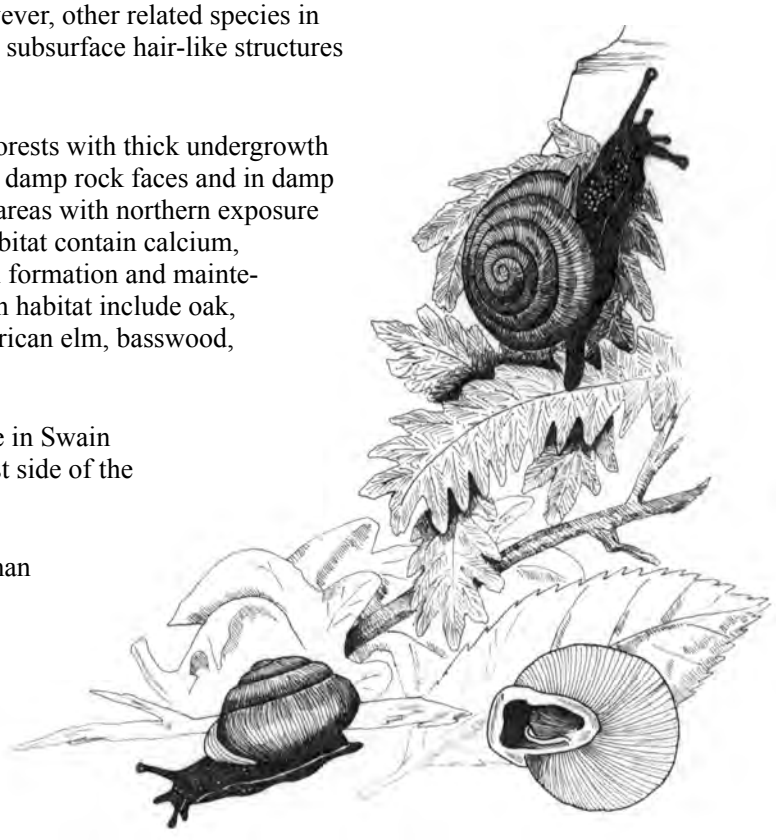
**Habitat:** Damp oak-hickory forests with thick undergrowth and rich, moist soils. Found on damp rock faces and in damp leaf litter. Prefers steep, rocky areas with northern exposure or wet ravines. Cliffs in this habitat contain calcium, which may be essential to shell formation and maintenance. Dominant tree species in habitat include oak, hickory, American beech, American elm, basswood, birch, and tulip poplar.

**Distribution:** Nantahala Gorge in Swain County. Occurs only on the east side of the gorge.

**Threats:** Both natural and human threats to habitat include forest fires, logging, destruction of cliff faces by climbing, road widening, and mine exploration, herbicide/pesticide spraying.

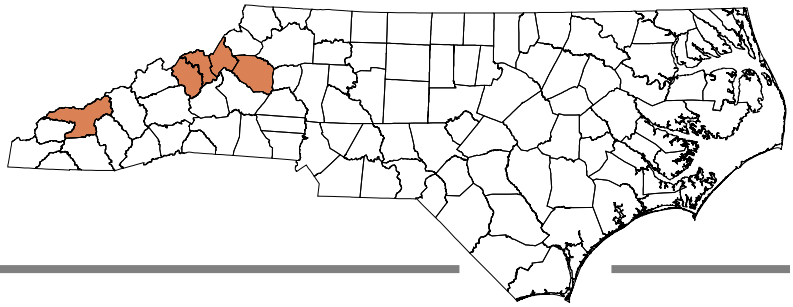
**Management Recommendations:** Protection of habitat from human destruction. Monitor natural stressors as well as human ones. Monitoring and learning the life processes of the species to document autecology.

*Sources: Lowe et al. 1990; Murdock pers. com.; USFWS 1992a, 1994c.*



# Arachnids
# Spruce-fir moss spider

*Microhexura montivaga*
Endangered (February 6, 1995)



**Description:** Coloration of *M. montivaga* ranges from light brown to darker reddish brown with no markings on the abdomen. The carapace is generally yellowish brown with chelicerae that project forward well beyond the anterior edge of the carapace. It has a pair of very long posterior spinnerets, and a second pair of book lungs that appear as light patches posterior to the genital furrow. Adults measure only 0.10-0.15 inch (2.5 - 3.8 mm) in length.

**Life History**: The spider constructs its tube-shaped webs in the interface between the moss mat and rock surface, occasionally extending the web into the interior of the moss mat. Although there are no records of prey being found in the webs, the species has been observed taking prey in the wild. The abundant springtails in the moss mats provide the most likely source of food for the spider. Males of the species mature during September and October, and females lay eggs in June. The thin-walled, transparent egg sac may contain seven to nine eggs. The female remains with the egg sac and will carry it with her fangs if disturbed. Spiderlings emerge in September. It is estimated that it may take three years for the species to reach maturity.

**Habitat:** The spruce-fir moss spider is found in damp but well-drained moss and liverwort mats growing on rocks or boulders and in well-shaded areas of mature, high-elevation Fraser fir and fir dominated spruce-fir forests. The moss mats cannot be too dry, as the species is very sensitive to desiccation, or too wet because large drops of water pose a threat to the spider.

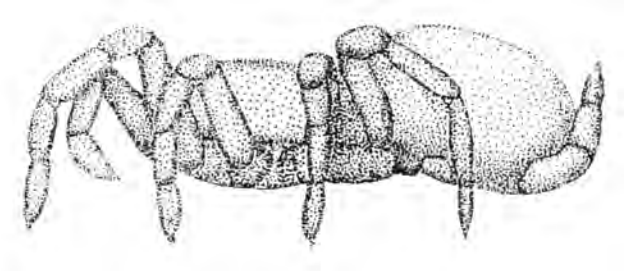
**Distribution:** The spider is known to only exist in six locations: Mount Collins and Clingmans Dome in Swain County, NC; Grandfather Mountain in Avery, Watauga, and Caldwell counties, NC; Roan Mountain in Avery and Mitchell counties, NC and Carter County, TN; and, Mount LeConte and Mount Buckley in Sevier County, TN. It is believed to be extirpated from Mount Mitchell in Yancy County*, NC.

**Threats:** The high-elevation spruce-fir forests through much of the species' historic range are being decimated by the exotic insect, balsam wooly adelgid (*Adelges piceae),* and possibly by air pollution (acid rain). The death and thinning of the forest canopy results in locally drastic changes in microclimate, including increased temperatures and decreased moisture which lead to desiccation of the moss mats on which the spruce-fir moss spider and its prey depend for survival. Other threats include unauthorized collecting or handling, unauthorized pesticide applications within the occupied habitat, intentional or unauthorized destruction of the habitat (burning, forest clearing, trampling, or other disturbance of the moss mats).

**Management Recommendations:** Protection from unauthorized and authorized disturbance of habitat and collection.

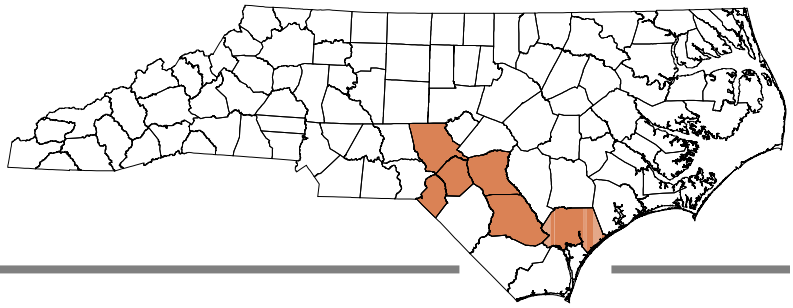
** No record has been reported in this county in the past 20 years.*

*Sources: USFWS 1995e, 1997c., 2000.*



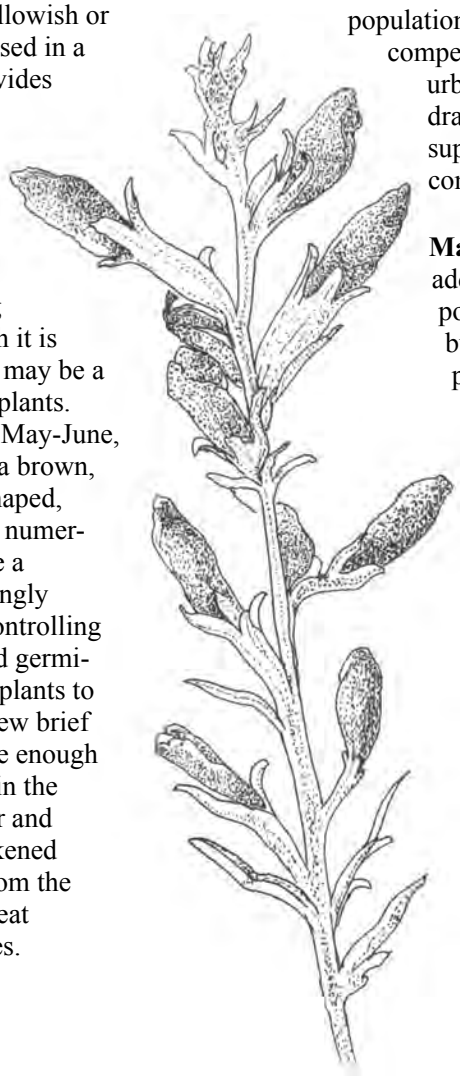
# American chaffseed

*Schwalbea americana*
Endangered (September 29, 1992)



**Description:** American chaffseed is an erect, densely hairy, unbranched perennial, 1-2 ft (30-60 cm) tall. Leaves are alternate, 0.8-1.6 inches (2-4 cm) tall, 0.2-0.4 inch (6-10 mm) wide and attach directly to the stalk without a leaf stem. Each leaf has three noticeable veins. Flowers are grouped in a long terminal cluster. The sepals are fused to form a calyx in the shape of two unequal lips, 0.5-0.7 inch (14-18 mm) long, beneath the petals. The corolla are two-lipped and narrow, twice as long as the calyx. The upper lip is triangular, while the lower lip consists of three short, broad lobes, of which the middle one is notched. Coloration is yellowish or purplish. The numerous seeds are enclosed in a loose-fitting, sac-like structure that provides the basis for the common name, chaffseed.

**Life History:** The American chaffseed, with its hemiparasitic behavior, is considered to be one of the rarest root-parasite species of flowering plants in the southeastern U.S. Although it is not host-specific, a host is required and may be a wide variety of woody and herbaceous plants. Showy, insect-pollinated flowers occur May-June, with fruits maturing in August. Fruit is a brown, dry dehiscent capsule, narrowly oval-shaped, about 0.4 inches (1 cm) long. Seeds are numerous, flat, and winged. Fire appears to be a requirement for long-term viability strongly affecting the reproductive success by controlling conditions necessary for successful seed germination and possibly required for young plants to make their haustorial connection. The few brief months immediately following a fire are enough time for the minute seeds to germinate in the mineral soil under full sun without litter and competing vegetation. The coarse, thickened chaffseed capsule insulates the seeds from the higher temperature of the fire and the heat exposure may increase germination rates.



**Habitat:** Prefers sandy, acidic, seasonally moist soils in sunny or partly sunny areas subject to frequent fires in the growing season.

**Distribution:** Occurs on moist to dryish pine flatlands, pine savannas, and on longleaf pine/oak sandhills at the western edge of the coastal plain in Bladen*, Cumberland, Hoke, Moore, Pender*, and Scotland counties.

**Threats:** Rarity of populations and low numbers within the population make this species especially vulnerable to competition from other species and loss of habitat to urban development, road building, wetland drainage, and pine forest management. Fire suppression allows succession to proceed so that competition for light excludes this species.

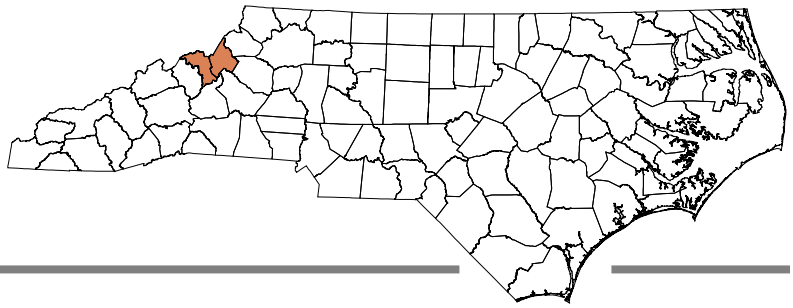
**Management Recommendations:** Need for additional research and monitoring of plant populations. Protection of habitat and prescribed burning to promote maintenance of extant populations.

** No record has been reported in this county in the past 20 years.*

*Sources: Jackson et al.1992, Radford et al. 1964, USFWS 1992a.*

# Blue Ridge goldenrod

*Solidago spithamaea*
Threatened, (March 28, 1985)



**Description:** The Blue Ridge goldenrod is a hairy perennial with stems erect and angled, 4-16 inches (10-41 cm) tall, and strongly ribbed at the base. The deep yellow-green leaves are distributed alternately along the stem. They are elliptically shaped, smooth-surfaced with toothed edges, 1.2-2.4 inches (3-6 cm) long and 0.3-0.8 inch (0.8-2 cm) wide, with pointed tips. The flower head forms a compact, flat-topped cluster of 20-30 yellow flowers. Petals on the outer (ray) flowers are 0.8-1.6 inches (2-4 cm) long.

**Life History:** Blue Ridge goldenrod is an early pioneer species. Plants spread vegetatively from short, stout rhizomes and occasionally reproduce by seed. Flowering occurs July-September. Fruit are small nutlets, 0.11-0.16 inch (2.8-4 mm) long, with hairs above the middle of the nutlet only and are present from July to October.

**Habitat:** Cliffs, ledges, balds, and rock outcrops of higher mountain peaks, above 4600 ft (1400 m) elevation that are exposed to full sun. Soils are generally acidic and shallow humus or clay loams, intermittently saturated.

**Distribution:** Endemic to mountains of North Carolina and Tennessee. Found in Avery and Mitchell counties.

**Threats:** Rarity of populations, small numbers, and being confined to isolated areas on a few rocky summits makes this species extremely vulnerable to trampling by hikers, climbers, and sightseers. Weather-related hazards include climatic extremes such as severe drought, ice and wind damage, and erosion of the steep habitat, which could decrease available suitable habitat adjacent to sources of seed and rhizomes. Erosion is often exacerbated by recreational over-use.

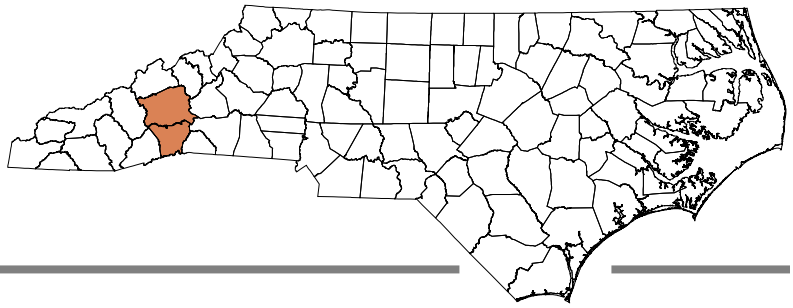
**Management Recommendations:** Preservation of existing plants and essential habitat. Search for additional populations. Enforce laws protecting the species and its habitat. Route hikers and other visitors away from sites.

*Note: Several other endangered plant species are ecological associates of the Blue Ridge goldenrod, including Heller's blazing star, Roan Mountain bluet, and spreading avens.*

*Sources: Hardin 1977; Lowe et al. 1990; Radford et al. 1964; USFWS 1987, 1992a.*

# Bunched arrowhead

*Sagittaria fasciculata*
(Clustered arrowhead, duck potato)
Endangered (July 25, 1979)



**Description:** Bunched arrowhead is a small emergent aquatic perennial 6-13 inches (36-40 cm) tall. Leaves are up to 12 inches (30 cm) long and taper downward into a long stalk, which attaches to the base of the plant. Long, parallel veins run almost the entire length of the leaf. Flowers grow in whorls of 2-3 at intervals on a long stalk. Each flower grows upward on its own stem from the main stalk, and has three petals and three sepals. The petals are white, 0.2-0.7 inch (6-18 mm) long. Seeds have broad wings and a wrinkled surface. Small, flat, linear leaves (phyllodia) can be seen under the water after emersed leaves die off.

**Life History:** Flowers from May to June and fruits from June to August. Bunched arrowhead is monoecious; upper flowers of the flowering stem are male and lower flowers are female. The stems of the lowest whorl of flowers ascend in fruit. The fruiting head is 0.2-0.6 inch (5-15 mm) broad, and is made up of numerous small, dry, single-seeded fruits. Each fruit is 0.10-0.14 inch (2.5-3.5 mm) long.

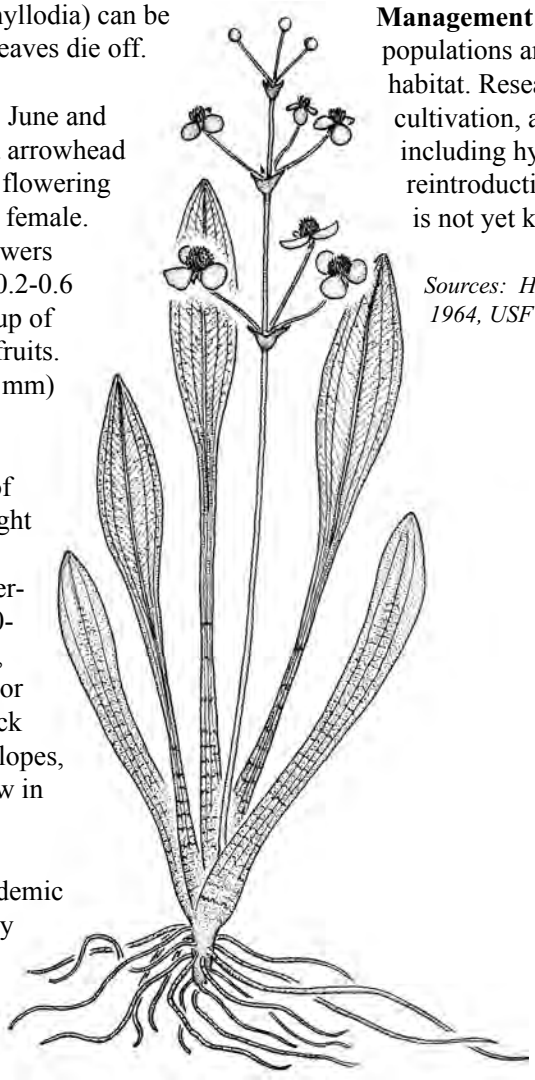
**Habitat:** Rooted in shallow water of bogs and wooded swamps with a slight but steady flow of cool, clean water. Often found in soils that are characteristically sandy loam covered with 10-24 inches (25-60 cm) of muck, sand, and silt. Plants will grow in full sun or partial shade beneath red maple, black gum, and alder at the base of steep slopes, but larger, more vigorous plants grow in shady areas.

**Distribution:** In North Carolina, endemic to limited areas of Henderson County in the southern mountains and into the upper piedmont of South Carolina. Also found historically in Buncombe County but not in the last 20 years.

**Threats:** Habitat degradation by drainage and clearing of land for development, highway, railway and powerline rights-of-way maintenance, water withdrawl and encroachment of woody plants.

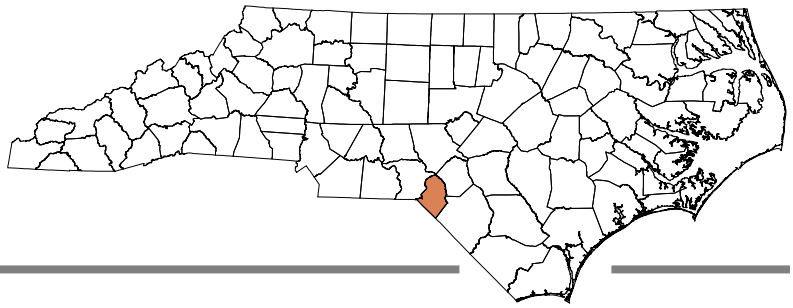
**Management Recommendations:** Identification of new populations and maintenance and protection of existing habitat. Research to learn more about the autecology, cultivation, and propagation techniques for restoration, including hydrology of extirpated populations. Some reintroduction efforts have been tried but their success is not yet known.

*Sources: Hardin 1977, Murdock pers. com., Radford et al. 1964, USFWS 1992a.*



# Canby's dropwort

*Oxypolis canbyi*
(Cowbane)
Endangered (February 25, 1986)



**Description:** Canby's dropwort is a herbaceous perennial with tuberous roots and pale, fleshy rhizomes. When crushed the plant gives off a dill-like fragrance. The stems are erect and stand up to 39 inches (1.2 m) tall and may be purplish at the base. The leaves are like quills. By flowering time, the lower leaves are absent. The flowers are small and white, with five petals, and grow in flat-topped clusters (umbels). The sepals are pale green, sometimes tinged with red.

**Habitat:** Moist areas in the coastal plain and sandhills such as Carolina bays, wet meadows, wet pineland savannas, ditches, sloughs, and edges of cypress/pine ponds. Best occurrences are in open bays and ponds with minimal cover that are wet for most of the year. It typically occurs on soils that are deep, acidic, with medium to high organic content and a high water table.

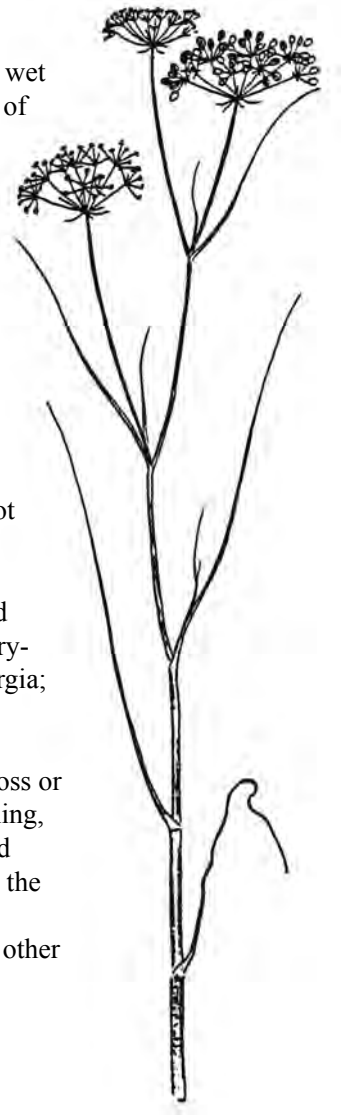
**Life History:** Flowering occurs May-early August. The fruit is flattened and broadly oblong, almost saucer-shaped, 0.2 to 0.3 inch (4-7 mm) long, with prominent lateral wings. Hogfennel (*O. filiformis*) is similar, but does not have large wings on the fruit.

**Distribution:** Known from one site in Scotland County in North Carolina. Present range is Maryland, North Carolina, South Carolina, and Georgia; historic in Delaware.

**Threats:** The most critical threat is the direct loss or alteration of the species' wetland habitat. Ditching, drainage, and subsequent bulldozing of lowland areas for agriculture and pine plantations alters the ground-water table. This enables succession to proceed leading to increased competition from other herbaceous species.

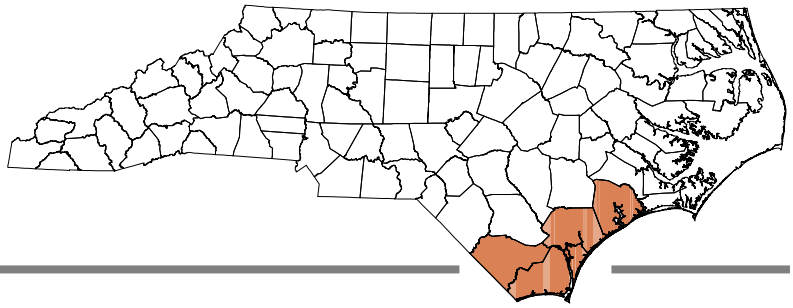
**Management Recommendations:** The population in Scotland County is owned in part by The Nature Conservancy. Monitoring is needed to determine whether the population is stable or changing, whether reproduction is vegetative or sexual through seeds, and if fire regimes are an essential part of the reproductive cycle.

*Sources: Jackson et al. 1992, Radford et al. 1964, USFWS 1992a.*



# Cooley's meadowrue

*Thalictrum cooleyi*
Endangered (March 9, 1989)



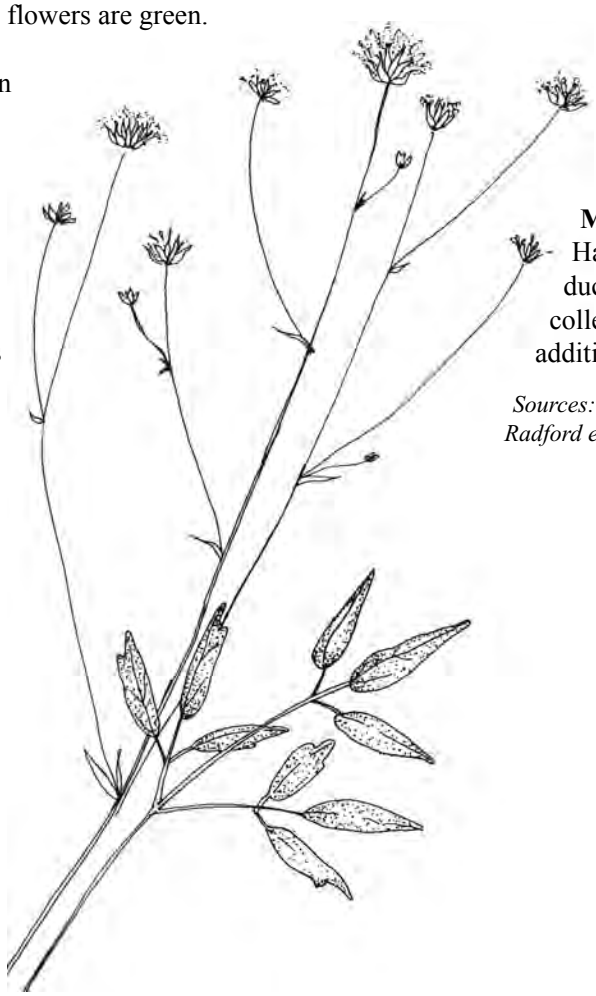
**Description:** A totally smooth perennial herb of the buttercup family, growing up to 39 inches (1 m) tall. It may grow as high as 6.5 ft (2 m) in recently burned areas. In full sun, the slender stems are erect, while under shady conditions they are lax, leaning or trailing along the ground. Leaves are divided into small leaflets, usually in groups of three, and may be doubly compound in lower leaves. The leaflets are green above and pale beneath, and while the shape varies, are usually oblong or lance-shaped, 0.1-2.4 inches (3-60 mm) long, 0.1-0.5 inch (2-12 mm) wide, with edges rolled under somewhat. Flowers are few and small and have no petals; sepals on male flowers are yellowish-white with lavender filaments, while sepals on female flowers are green.

**Life History:** Flowering occurs in June. Fruiting occurs August-September; seeds remain on the plants until October. The fruits are small, hard, and dry, with one seed each, 0.18-0.24 inch (4.5-6 mm) long and 0.06-0.08 inch (1.5-2 mm) broad. Few seedlings are found in the wild. Lab studies indicate poor seed germination and a short seed life.

**Habitat:** Moist to wet bogs and savannas kept open by frequent fire or other disturbance, fire plow lines, roadside ditches, forest clearings dominated by grass or sedge, and powerline rights-of-way. Often grows in association with tulip poplar (*Liriodendron tulipifera*) cypress and/or Atlantic white cedar (*Chamaecyparis thyoides*).

**Distribution:** Endemic to the Southeastern coastal plain with 11 locations in North Carolina and 1 in Florida. Populations extant in Brunswick, Columbus, Onslow, and Pender counties. May occur in New Hanover County although record is over 20 years old.

**Threats:** Endangered by fire suppression, mining, drainage activities associated with silviculture and agriculture, and residential and industrial development. While it can withstand some timber harvesting operations if properly done, this species cannot withstand bulldozing, drainage of habitat as it is converted to pine plantation, highway construction and maintenance, or direct herbicide application. Fire suppression has already resulted in extirpation of 25% of the known populations since discovery. Disturbance that opens up the landscape to full sun is conducive to species success if mowing is done in the early part of the growing season.

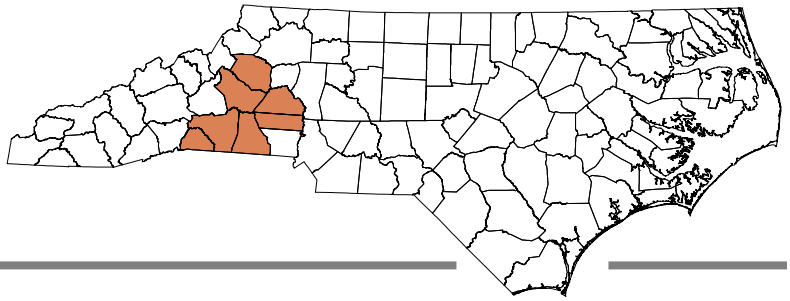


**Management Recommendations:** Habitat protection, prescribed fire, reintroduction into historic habitat, and study and collection of genetic materials. Search for additional populations and potential habitat.

*Sources: Boyer 1994, Jackson et al. 1992, Jordan 1995, Radford et al. 1964, USFWS 1992a.*

# Dwarf-flowered heartleaf

*Hexastylis naniflora*
(Dwarf-flowered wild ginger)
Threatened (March 9, 1989)

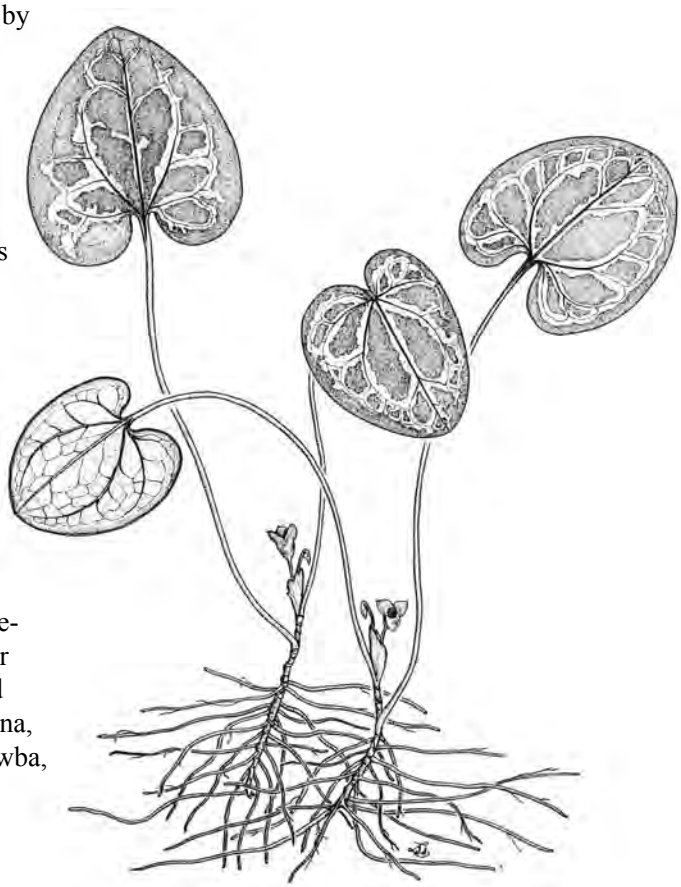


**Description:** Dwarf-flowered heartleaf is a low-growing, spicy-smelling, evergreen perennial herb that spreads via rhizomes. Leaves are heart-shaped, alternate, leathery, untoothed, and 1.6-2.4 inches (4-6 cm) long and wide. Each leaf is supported by a long, thin petiole (stem) that rises directly from the subsurface rhizome. The solitary flowers are fleshy, firm, grow at the end of short stalks, and often are under forest litter and leaves near the base of the leaf petioles. The flowers are jug-shaped, .23-5 inches (6-13 mm) long and .15-.27 inches (4-7 mm) in diameter, and have a tubular caylx, ranging in color from brown to greenish or purple.

**Life History**: Flowering occurs from mid March to early June; fruiting begins in late May. Seeds may be distributed via ants. Flowers are pollinated by flies and thrips. Adults are rhizomatous and seedling growth has been observed in clumps of mature plants.

**Habitat:** Along bluffs and north-facing slopes, boggy areas along streams, and adjacent hillsides and ravines with acid, sandy loam soils in deciduous forests. Usually associated with *Kalmia latifolia* or *Asimina triloba.* Typically found on these soil types: Pacolet or Madison gravelly sandy loam, or Musella fine sandy loam.

**Distribution:** Endemic to a nine-county area in the western upper piedmont of North Carolina and South Carolina. In North Carolina, found in Burke, Caldwell, Catawba, Cleveland, Lincoln, Polk, and Rutherford counties.



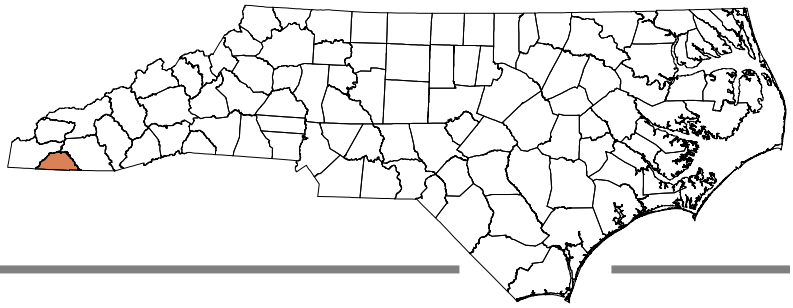
**Threats:** Habitat and population destruction from residential and road construction, urbanization, and associated erosion.

**Management Recommendations:** Protection of habitat of existing populations. Increase public awareness through education.

*Sources: Radford et al. 1964, USFWS 1992a.*

# Green pitcher plant

*Sarracenia oreophila*
Endangered (September 21, 1979)



**Description**: The green pitcher plant is an insectivorous, rhizomatous perennial, 8-30 inches (20-75 cm) tall, with green to yellow-green tubular, pitcher-like leaves. Leaves widen near the top, with a flaring mouth, and are topped with a hood. The hood is large, tilts upward slightly, and has a keel, or ridge, down the back. When the leaves are exposed to sunlight, they may develop reddish veins and a purple blotch at the mouth of the pitcher. A solitary, nodding, yellow flower blooms at the top of a 18-28 inches (45-70 cm) long stem. The pitchers contain liquid and enzymes. Insects that fall into the pitchers are digested and nutrients from their bodies are absorbed into the plant's tissue.

**Life History:** Pitchers and flower buds appear in early April. Flowering occurs mid-April to early June. Pitchers die off around mid-summer, and are replaced by small, flat, sharply curved leaves (phyllodia), which persist until the following spring. The numerous phyllodia are an important feature in distinguishing this species from other pitcher plants. There is considerable interaction with insects that function as pollinators (queen bumblebees) and feed on particulate matter in the pitcher fluid as well as plant tissue, and serve as prey providing a mineral supplement for the plant in the nutrient poor habitats. Reproduces both sexually (by seed) and asexually (by rhizomes) but the latter appears to be dominant.

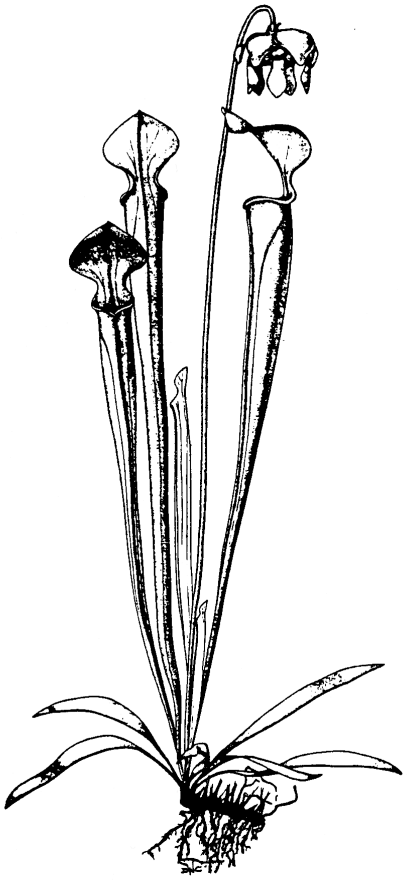
**Habitat:** Favors highly acidic soils that are wet at least part of the growing season. Habitat varies, ranging from seepage bogs to streambanks in North Carolina and Alabama. Occurs in poorly drained oak and oak-pine flatwoods in Georgia. May require periodic fire to impede the growth of competing woody plants. Thrives on nutrient-poor soils.

**Distribution:** Restricted to areas of the Cumberland Plateau, the Ridge and Valley province in northeast Alabama, and the Blue Ridge of Georgia and North Carolina. It previously occurred in the coastal plain and piedmont of Alabama and Georgia and the Cumberland Plateau of east Tennessee.

**Threats:** Shrub and tree encroachment due to fire suppression, degradation of habitat by residential and road construction, drainage from agricultural and silviculture practices, commercial/amateur collection of live plants. Flooding and streambank changes due to human disturbance have also caused plant loss.

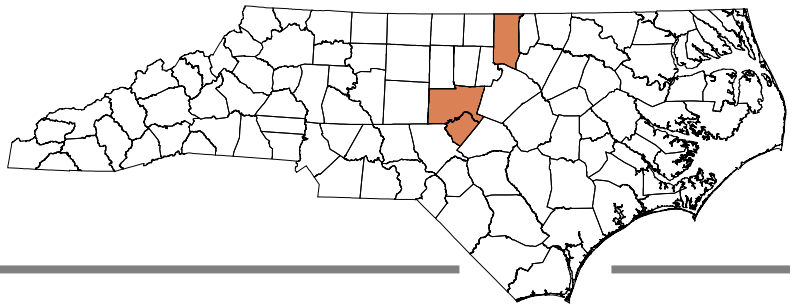
**Management Recommendations:** Restore natural hydrology to degraded habitat. Provide protection to existing populations and habitat. Burn where necessary.

*Sources: Lowe et al. 1990, Radford et al.1964, Schnell 1976, USFWS 1992a.*



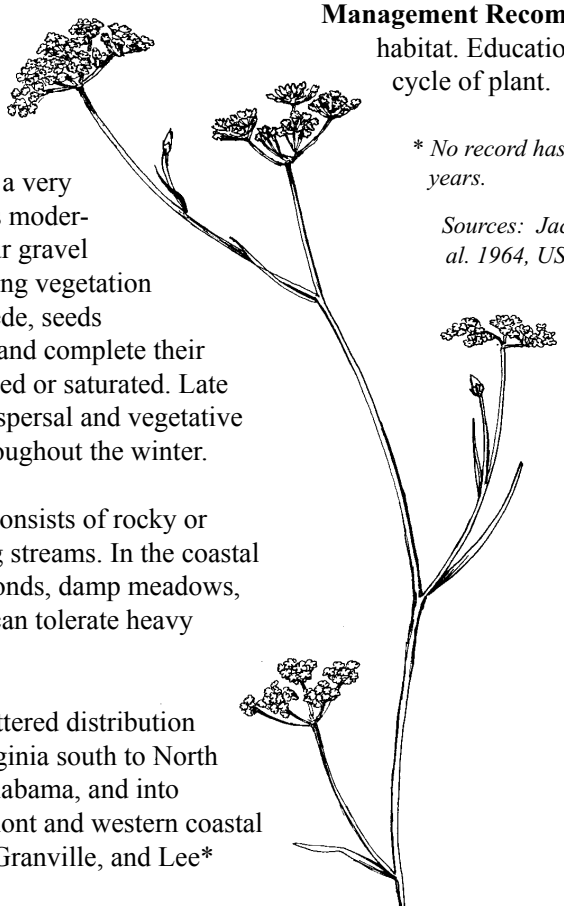
# Harperella

*Ptilimnium nodosum (Harperella nodosa*)
(Bishop's weed)
Endangered (September 28, 1988)



**Description**: Harperella is an annual plant ranging from 6-36 inches (0.15-1 m) in height, with weak stems. Leaves are hollow, quill-like structures. The plant is aromatic and smells like dill. Flat clusters of small white flowers top the stems, similar to Queen Anne's lace *(Daucus carota)*. They bloom intermittently from May until the first frost. Seeds are elliptical and laterally compressed, up to 0.08 inch (2.0 mm) long.

**Life History:** Flowering begins in May in pond habitat populations, and in late June or July in riverine populations and continues until frost. The pollination process has not been studied, but seed set appears to be profuse since populations can achieve high density and numbers of individuals in localized areas each year, especially along rivers. This plant tolerates, and may require, a very specific water regime, which includes moderately intensive spring floods that scour gravel bars and rock crevices where competing vegetation may take hold. After floodwaters recede, seeds germinate in shallow rocky crevices and complete their life cycles with root systems submerged or saturated. Late summer high water facilitates seed dispersal and vegetative rooting and protects young plants throughout the winter.



**Habitat:** Habitat in North Carolina consists of rocky or gravelly shoals of clear, swift-flowing streams. In the coastal plain, it grows at edges of pineland ponds, damp meadows, and soggy ground around springs. It can tolerate heavy shade.

**Distribution:** Has an arc-shaped, scattered distribution from western Maryland and West Virginia south to North Carolina, South Carolina, Georgia, Alabama, and into Arkansas. Found in the eastern piedmont and western coastal plain of North Carolina in Chatham, Granville, and Lee* counties.

**Threats:** Because harperella's life cycle depends on water levels fluctuating at appropriate times in the growth cycle, it can be easily extirpated from an area by seemingly minor perturbations, either natural or human-caused. Degradation and loss of habitat from ditching and draining of ponds, dredging, impoundments, siltation from construction and mining activities and excessive nutrient loading of streams affect the survival of this species. Bank stabilization for boater access also destroys plants and habitat. Over half of the historically known populations have been eliminated by such factors.

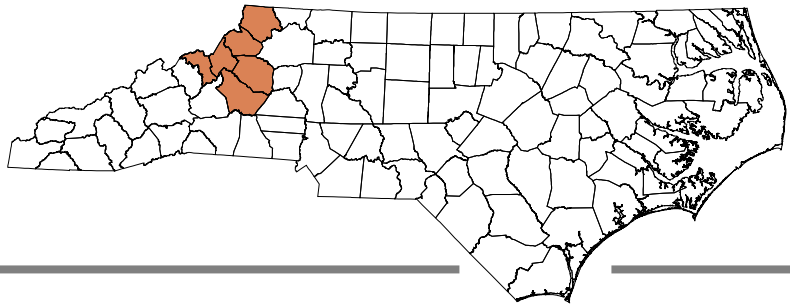
**Management Recommendations:** Protection of species and habitat. Education of landowners about habitat and life cycle of plant.

** No record has been reported in this county in the past 20 years.*

*Sources: Jackson et al. 1992, Lowe et al. 1990, Radford et al. 1964, USFWS 1992a.*

# Heller's blazing star

*Liatris helleri*
(Heller's gayfeather)
Threatened (November 19, 1987)



**Description**: Heller's blazing star is a perennial herb of the aster family with one or more erect stems up to 16 inches (40 cm) tall, which grow from a tuft of pale green leaves at the base of the plant. Upper leaves are alternate, long and narrow. Flowers are tubular, lavender, and are clustered into heads which are scattered along the stem in a showy spike, 3-8 inches long. Fruits are small nutlets. Note: there are several similar species; the most reliable distinguishing characteristic of Heller's blazing star is that the outer protective parts of the flower (the pappus) are only half or less the length of the entire tube that makes up the flower. In other species, the protective parts (pappus) are more than half the length of the flower tube.

**Life History:** Very little is known of the autecology of this plant. Flowering occurs from July to September. Seeds are present September to October.

**Habitat:** High-elevation, rock ledges in shallow, acidic soil exposed to full sunlight.

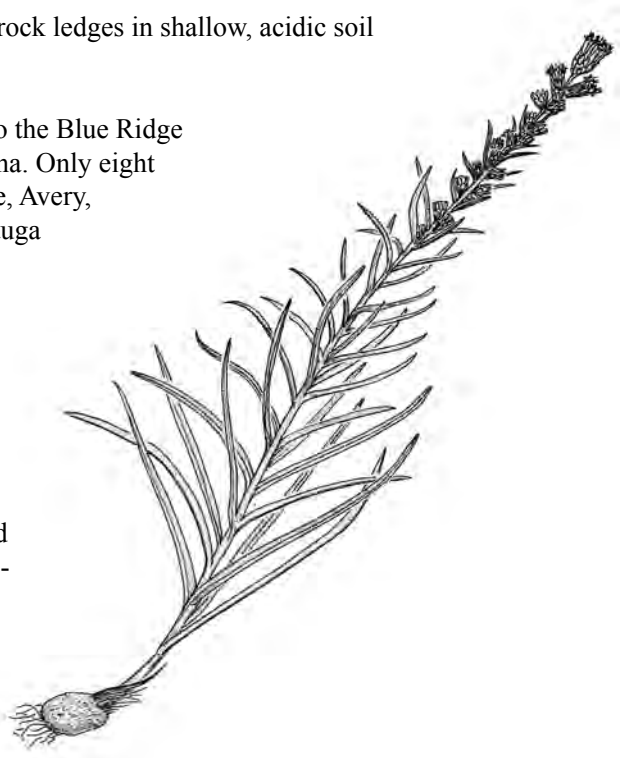
**Distributions:** Endemic to the Blue Ridge mountains of North Carolina. Only eight populations remain in Ashe, Avery, Burke, Caldwell, and Watauga counties. Populations in Mitchell County have apparently been destroyed.

**Threats:** Little is known about why this species is declining and vanishing. Suspected reasons for decline are commercial and heavy recreational development. Soil erosion and compaction from road and building construction degrade the species' habitat. Trampling by hikers, climbers, and sightseers creates additional stress to plants and habitat. Other potential threats are natural disturbance from rock slides, severe droughts, acid precipitation, fire suppression, as well as possible lack of genetic variability due to small numbers and isolated locations of the populations.

**Management Recommendations:** Habitat and population protection and education of private landowners. Development and activation of management plans to prevent further loss by succession. Prescribed burns have been beneficial to the species on US Forest Service land.

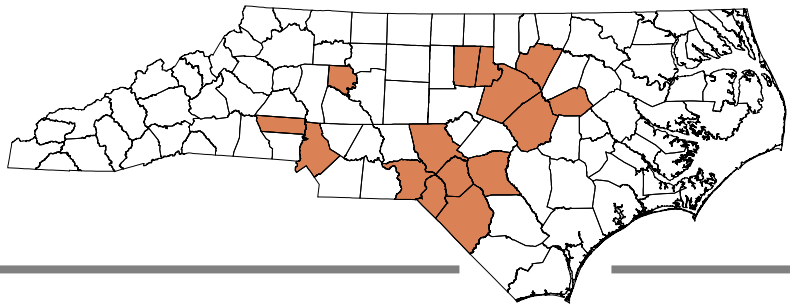
**Note:** Blue Ridge goldenrod, Roan Mountain bluet, and spreading avens, all of which are federally listed species, may be found in association with Heller's blazing star.

*Sources: Radford et al. 1964, USFWS 1992a .*



# Michaux's sumac

*Rhus michauxii*
(False poison sumac, dwarf sumac)
Endangered (September 28, 1989)



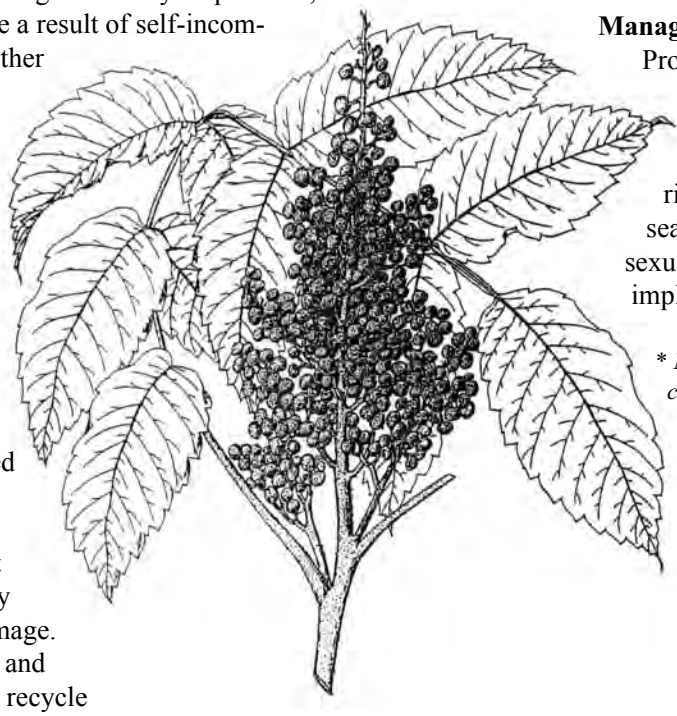
**Description:** Michaux's sumac is a non-poisonous, low-growing, deciduous, densely hairy shrub. The erect stems grow from an underground rhizome to a height of 1-3 ft (30-91 cm). The compound leaves are alternate and divided into long rows of 9-13 stalkless leaflets. The leaflets are 1.6-3.5 inches (4-9 cm) long, oblong, winged at the base, dull on the top, hairy on the bottoms, with toothed edges. The terminal leaflet has a 2 inch (5 cm) long winged petiole. Flowers grow at the top of the plant in a dense, erect cluster, colored greenish-yellow to white, and are 4-5 parted. Fruit are hairy reddish drupes, each containing one seed.

**Life History:** Leaves emerge in April to May, flowering occurs April to June, and fruiting occurs August to October with fruits persisting for several months. Plants are generally dioecious. Plants have been known to produce male flowers one year and female flowers the next. Other plants are monoecious with both male and female flowers at one time. Usually less than half of the stems in a subpopulation do not flower in a given season. Even though fruit may be plentiful, seed viability is low. This may be a result of self-incompatibility or hybridization with other *Rhus.* Species usually produces asexually from thick, shallow horizontal rhizomes. The low reproductive capacity is probably the most crucial factor endangering this species.

**Habitat:** Sandy, loamy swales and depressions, acidic and circumneutral uplands, and rocky open woods. Grows best where disturbance has maintained an open area. Has been found along roadsides, in powerline clearings, and areas where forest canopies have been opened up by blowdowns and/or hurricane damage. Episodic fires accentuate habitat and reduce hardwood encroachment, recycle nutrients, and aid regeneration of longleaf pine/wiregrass communities.

**Distribution:** Endemic to the inner coastal plain and lower piedmont of North Carolina, South Carolina, Virginia, and Georgia. In North Carolina, it is found in Cumberland, Davie, Durham*, Franklin, Hoke, Johnston*, Lincoln*, Mecklenburg*, Moore, Orange*, Richmond, Robeson, Scotland, Wake, and Wilson* counties.

**Threats:** Decline in longleaf pine/wiregrass/*Rhus michauxii* habitat because of suppression of natural, periodic fire regime, allowing succession to proceed which results in crowding and shading out of *Rhus* by other competitive plants. Habitat is lost to agriculture, silviculture, commercial and residential development, road construction and improvement. Other threats to the small, geographically isolated, unisex populations are hybridization with other *Rhus* species, fungal disease, and stem borers.



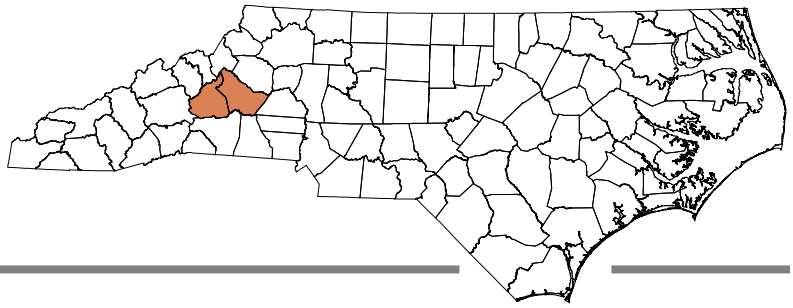
**Management Recommendations:** Protection of habitat and present populations by keeping areas open with prescribed fire regime, timber harvesting, and appropriate right-of-way maintenance. Research into genetic reasons for low sexual reproduction and hybridization implications.

** No record has been reported in this county in the past 20 years.*

*Sources: Jackson et al. 1992, Radford et al. 1964, USFWS 1992a.*

# Mountain golden-heather

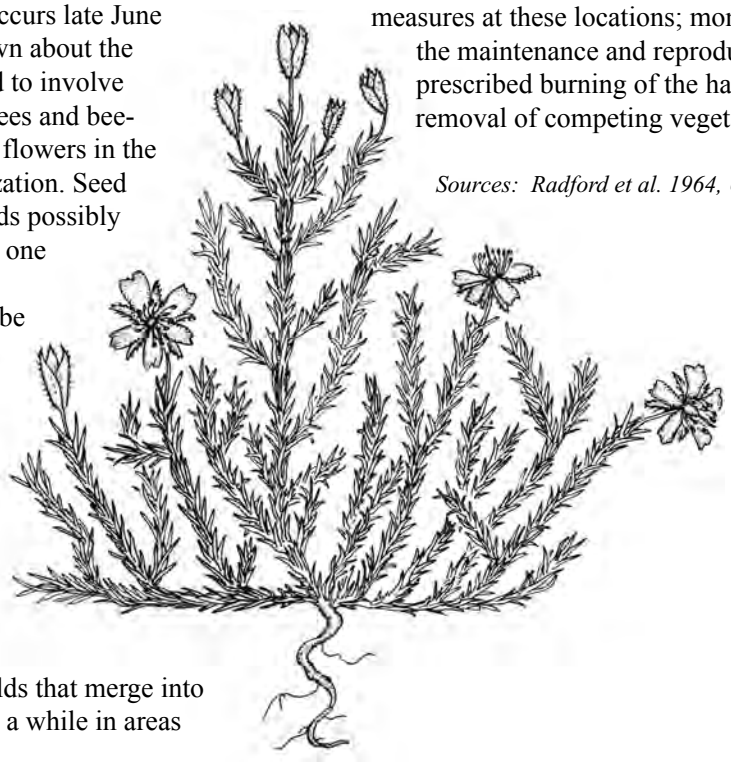
*Hudsonia montana*
(Mountain hudsonia)
Threatened (October 20, 1980)



**Description:** Mountain golden-heather is a low, spreading, freely branching shrub, somewhat like a large moss or low juniper, usually about 6 inches (15 cm) high. The needle-like leaves are alternate, about 0.11-0.27 inches (3-7 mm) long, and point toward the tops of the branches. The plant may be yellow-green, especially when growing in shade. Leaves from previous years, although dead and brown, will persist, scale-like on the older branches. Solitary flowers about 1 inch (2.5 cm) across grow at the ends of branches on a short stalk. Five yellow petals, five hairy sepals, and 20-30 stamens are on each flower. Petals are twice as long as sepals. Each flower lasts only one day, from early morning until late afternoon when the petals wither and shed. All other flower parts persist. Fruit is roundish, hairy, and on a 0.5 inch (1.2 cm) stalk. The opened capsule may persist for a year or more.

**Life History:** Leaves appear in May, flowering occurs late May through June, and fruiting occurs late June through September. Little is known about the breeding system but it is assumed to involve occasional cross-pollination by bees and bee-like flies, although closing of the flowers in the afternoon may induce self-fertilization. Seed dispersal appears limited and seeds possibly remain in the soil over more than one growing season, suggesting that disturbance of the soil crust may be necessary for seedling establishment. Flowering does not occur until the third year, and vegetative reproduction is slow.

**Habitat:** Rock cliffs and shrub balds at high elevations, 2800 to 4000 ft (854 to 1,220 m). Prefers exposed quartzite ledges in an ecotone between bare rock and *Leiophyllum*-dominated heath balds that merge into pine/oak forests. May survive for a while in areas shaded by pines, but is dependent on fire to maintain habitat in suitably open condition.



**Distribution:** Endemic to the North Carolina mountains. Populations found in Burke and McDowell counties, within the Pisgah National Forest.

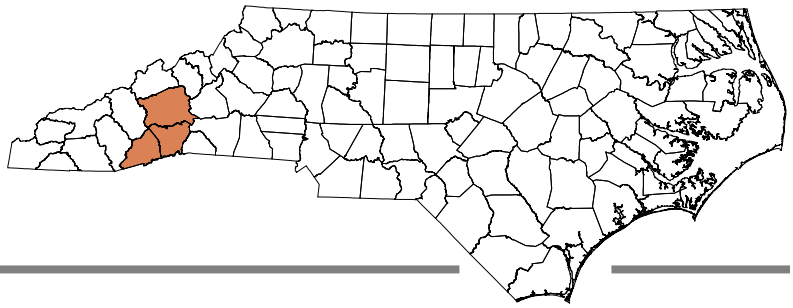
**Threats:** Trampling, soil compaction by campers, rock climbers, and other recreationalists. Reduced size and vigor of populations, a result of competition with other shrubs, increases the species' vulnerability to extinction. Requires periodic fire.

**Management Recommendations:** Regulations restricting climbing, camping, and off-trail hiking on designated ledges; consideration of plant requirements in trail maintenance operations; realignment of trails at locations where they pose a threat to the plant; implementation of erosion control measures at these locations; monitoring studies to evaluate the maintenance and reproduction of the plant; and prescribed burning of the habitat and/or mechanical removal of competing vegetation.

*Sources: Radford et al. 1964, USFWS 1992a.*

# Mountain sweet pitcher plant

*Sarracenia rubra* ssp. *jonesii*
(Trumpets, dumb-watches, Eve's cups, fly bugles)
Endangered (September 30, 1988)

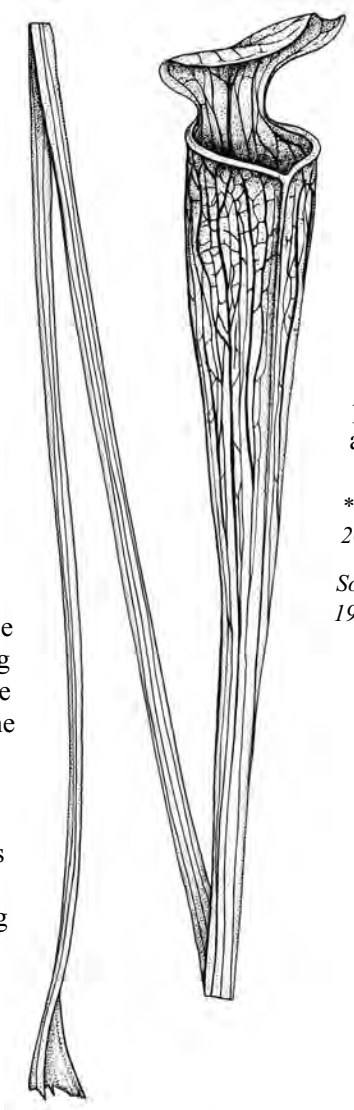


**Description:** Mountain sweet pitcherplant is an insectivorous, rhizomatous, perennial herb with hollow, pitcher-like leaves, up to 29 inches (73 cm) tall. There is a narrow, linear ridge (wing) on one side of the leaf, and a heart-shaped hood at the top which is usually erect and 0.4-1.2 inches (1-3 cm) wide. When viewed from the side, the leaves appear trumpet shaped. Mature leaves have red veins on a coppery green background. Leaves usually die off with the first frost. The first leaves to form in the spring look somewhat deformed, with a wide wing along the leaf, a small pitcher tube, and an 'S' shaped curvature. Flowers are solitary and sweet-smelling, 0.8-1.2 inches (2-3 cm) long, with petals that are usually maroon on the outer surface. There may be more than one flower per plant. The fruit is a dry capsule, 0.2-0.6 inch (5-15 mm) in diameter. Insects that fall into the hairy, trumpet-like pitcher leaves are digested in liquid containing enzymes. Nutrients (minerals) from their bodies are absorbed by the plant tissue. Although not completely understood, this process may allow carnivorous species to compete in nutrient poor habitats.

**Life History:** Like other pitcher plants, it can reproduce vegetatively by rhizomes for decades without sexual reproduction by seeds. This lack of sexual reproduction is a great concern because even though the rhizomes are persistent and long lasting (20-35 years), the older plants cannot live indefinitely. Flowering occurs April through June with fruiting in June through July.

**Habitat:** Endemic to a few mountain bogs and stream banks; usually found in level depressions associated with floodplains. Some populations grow along waterfalls on granite rock faces. Bog habitats have deep, saturated soils containing loam, sand, and silt with a high organic matter content and medium to high acidity, dominated by shrubs and herbs. Historically, the bogs were probably kept open by natural disturbances like water fluctuation, beaver activity, and the constantly high water table in the bogs which does not permit woody seedlings to become established.

**Distribution:** Limited to ten populations in the southern mountains of North Carolina and South Carolina. In North Carolina, reported in Buncombe*, Henderson, and Transylvania counties.



**Threats:** Overcollection of plants, trampling by humans and livestock; degradation of habitat by drainage of wetlands, impoundment, cultivation and over-grazing, natural succession, and recreational development (the single most significant threat to this plant, especially golf courses).

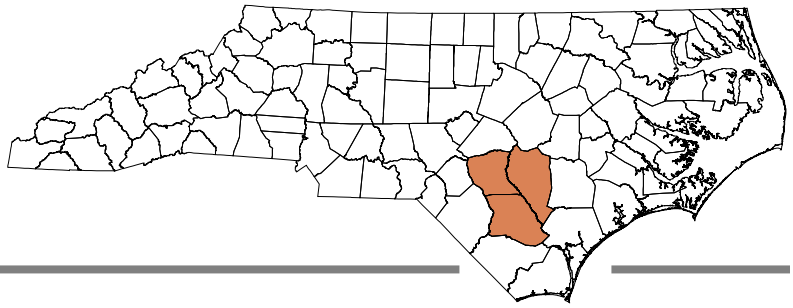
**Management Recommendations:** Protect existing populations and habitat. Educate private landowners in protection and management of the species sites. Search for additional populations. Study and research species autecology and habitat characteristics.

** No record has been reported in this county in the past 20 years.*

*Sources: Radford et al. 1964; Schnell 1976; USFWS 1992a, 1995a.*

# Pondberry

*Lindera melissifolia*
(Hairy spicebush, southern spicebush, swamp spicebush)
Endangered (July 31, 1986)

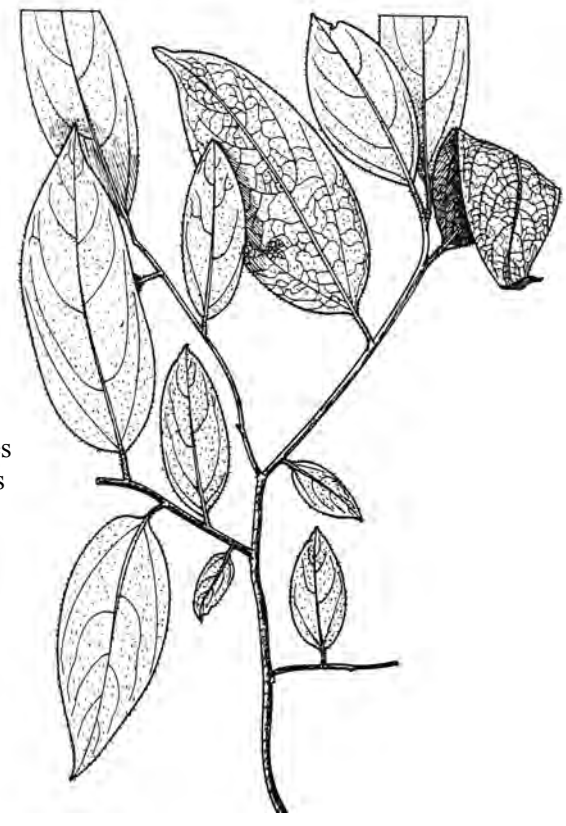


**Description:** Pondberry is an aromatic, deciduous shrub with erect stems and shoots, growing as high as 6.5 ft (2 m). It spreads vegetatively by above ground shoots (stolons). Young stems and leaves are hairy. Leaves are alternate, drooping, and oblong, with hairy edges, a pointed tip and rounded base, 2-4 inches (5-10 cm) long and 0.6-1.4 inches (1.5-3.5 cm) wide. Small, pale, clustered flowers appear before leaves from February to April. Common spicebush *(Lindera benzoin)* is taller, 6.5-16.4 ft (2-5 m) with leaves that do not droop, are tapered at the base, and smell like benzene when crushed. Pond spice (*Litsea aestivalis)* is taller with shorter, leathery leaves. Pondberry is characterized by the sassafras-like odor of its crushed leaves and tendency to form thickets of clonal, unbranched stems (100-10,000).

**Life History:** Flowers appear from February through April before leaf and shoot growth begins in late April. Fruiting occurs from August to September. The fruit matures in late autumn and is fleshy, oval, bright red, about 0.25-0.50 inch (6-10 mm) in diameter, but appears to have no reproductive value. Flowers are unisex and plants are mostly dioecious.

**Habitat:** Bottomland hardwood forests in inland areas, poorly drained swampy depressions, and edges of limestone sinks and ponds closer to the coast. Occurs at the edges of swamps and ponds and depressions in forests of longleaf pine and pond pine forests. Typically found in somewhat shaded areas, but can also grow in full sun.

**Distribution:** Southern coastal plain in Bladen*, Cumberland, and Sampson counties.



**Threats:** Endangered by degradation and destruction of plants and habitat by land clearing and drainage operations, timber harvesting and other forest management practices that eliminate forest canopy and change hydrology of the soil, encroachment by competitor species, and fungal disease that causes the plant to wilt.

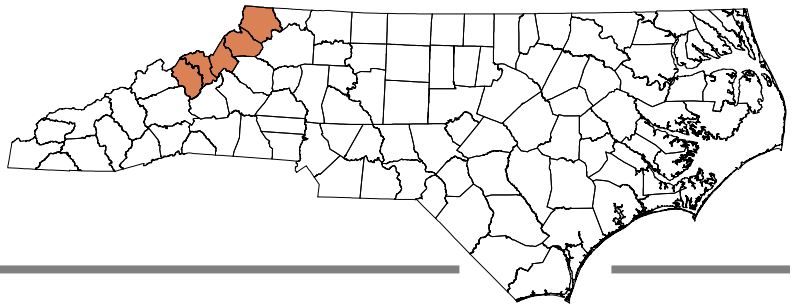
**Management Recommendations:** Protection of existing populations and habitat by buffer zones around sites to protect the hydrology of the site as well as damage from road construction and management, clear cutting and other forest management practices.

** No record has been reported in this county in the past 20 years.*

*Sources: Jackson et al. 1992, Jordan et al. 1995, Radford et al. 1964, USFWS 1992a.*

# Roan Mountain bluet

*Houstonia montana*
*(=Hedyotis purpurea* var. *montana)*
Endangered (April 5, 1990)



**Description:** Roan Mountain bluet, a perennial herb of the coffee family, grows in low, loose tufts 4-6 inches (10-15 cm) tall. The small leaves along the erect stems are lance- or ellipse-shaped, 0.2-1.2 inches (0.8-3 cm) long; stems are four-angled. A rosette of leaves also grows at the base of the shallow-rooted plant, but may not be visible during flowering. The funnel-shaped flowers grow in flat-topped clusters colored bright, deep purple, each cluster containing only 1-4 flowers. This plant is distinguished from *Hedyotis purpurea* var. *purpurea* by a larger flower size, larger seed size, and by the different flower color, deep reddish-purple instead of bluish-purple or white.

**Life History:** Flowering occurs May through September. The fruit is a small, round capsule containing many seeds. Four main pollinators are small staphylined beetles, bumblebees, flies, and ants.

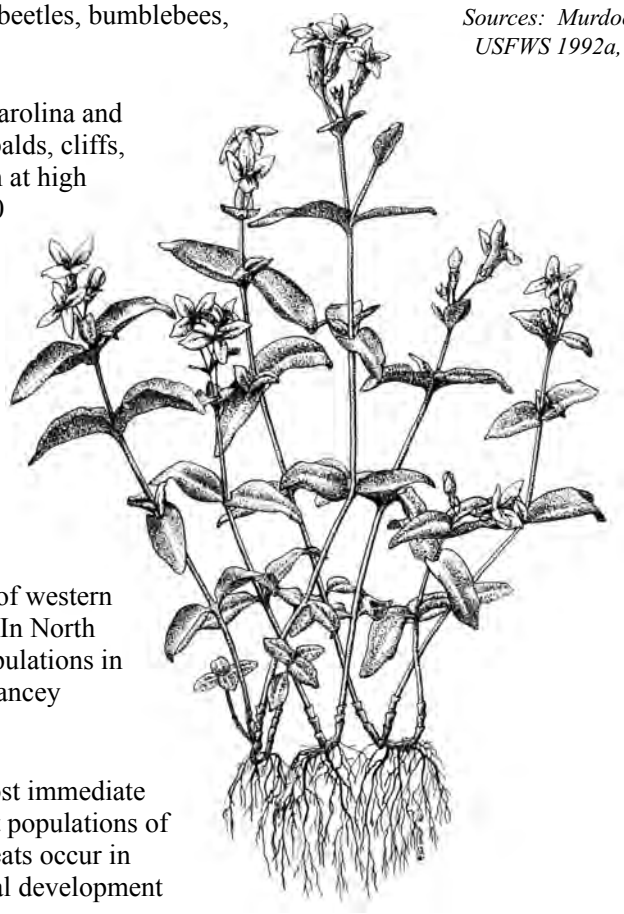
**Habitat:** Endemic to western North Carolina and eastern Tennessee, it grows on grassy balds, cliffs, outcrops, and steep slopes with full sun at high elevations 4,590-6,230 feet (1400-1900 m). It typically grows in gravelly filled pockets between rocks. Adjacent forests are dominated by red spruce *(Picea rubens)* and Fraser fir *(Abies fraseri)*. Known soil substrate is usually composed of metamorphic and acidic rocks. Usually shares habitat with other federally listed species: Heller's blazing star, Blue Ridge goldenrod, and spreading avens.

**Distribution:** Scattered mountaintops of western North Carolina and eastern Tennessee. In North Carolina, exists in only fragmented populations in Ashe, Avery, Mitchell, Watauga, and Yancey counties.

**Threats:** Habitat destruction is the most immediate and prevalent threat to nearly all extant populations of Roan Mountain bluet. The greatest threats occur in commercial, residential and recreational development at privately owned sites. Hikers, rock climbers, and other sightseers create erosion and compaction of soil at cliff and trail side locations on national forest lands, often trampling populations and habitat. Blowdown of weakened and killed trees due to air pollution and infestation of wooly aphid allows soil erosion and loss of habitat.

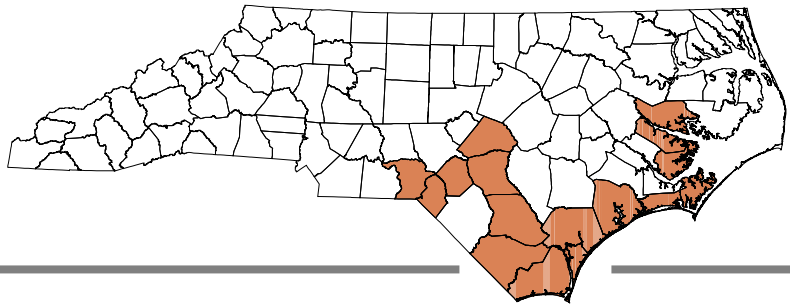
**Management Recommendations:** Survey suitable habitat for additional populations; monitor and protect existing populations by avoiding new construction of paths and platforms near population sites; erect fences separating sites from existing trails and sightseeing points; conduct research on autecology and management needs of species; and restore populations to historic sites.

*Sources: Murdock per. com; Radford et al. 1964; USFWS 1992a, 1996b.*



# Rough-leaved loosestrife

*Lysimachia asperulifolia*
Endangered (June 12, 1987)



**Description:** Rough-leaved loosestrife is an erect, rhizomatous perennial, 1-2 feet (30-60 cm) tall. Stems are slender, rarely branched, and glandular, especially near the top. Leaves occur in whorls of 3-4, each 0.8-1.6 inches (2-4 cm) long, 0.3-0.8 inch (0.8-2 cm) wide, lance-shaped, with rounded bases. The leaves attach to the stem directly, with no petiole. Aside from glands near the base and along the veins, the leaves are smooth. Flowers are clustered along the top of the main stalk. Flowers have five yellow petals fused at the base, and five sepals fused together at the base.

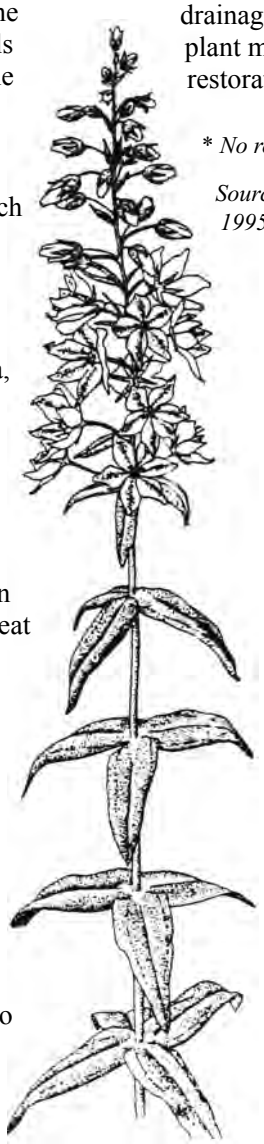
**Life History**: Flowering occurs from May to June. Seeds are encased in a rounded capsule 0.12-0.14 inch (3-3.5 mm) long and present from July to October.

**Habitat:** Grass-shrub ecotones where species is found are fire maintained, as are the adjacent plant communities - longleaf pine/scrub oak, pine savanna, flatwoods, and pocosins. Prefers full sunlight; shade intolerant. Grows primarily in ecotones between longleaf pine uplands and pond pine pocosins in dense shrub and vine growth. Has been found in other ecotones as well. Requires disturbed areas where the overstory is minimal. Prefers moist to seasonally saturated sand and shallow organic soil on top of sand (spodosolic soils). Also grows on deep peat soils of Carolina bays. Has been found in roadside depressions, firebreaks, seeps, and powerline rights-of-way.

**Distribution:** Endemic to the coastal plain and sandhills of the Carolinas. Reported in North Carolina in Beaufort, Bladen, Brunswick, Carteret, Columbus*, Cumberland, Harnett, Hoke, New Hanover, Onslow, Pamlico, Pender, Richmond*, and Scotland counties.

**Threats:** Habitat degradation and destruction due to suppression of natural fire regime, drainage activities associated with silviculture, agricultural, residential and industrial development. Fire suppression results in increase in density and height of competing shrubs. Drainage alters hydrology of moist depressions.

**Management Recommendations:** Protection of public and privately owned species population sites and maintenance by periodic prescribed burning regime to impede succession. Protection from adverse habitat alteration by ditching and drainage activities. Collection and storage of seeds and plant material to be used in propagation, research, and restoration projects.

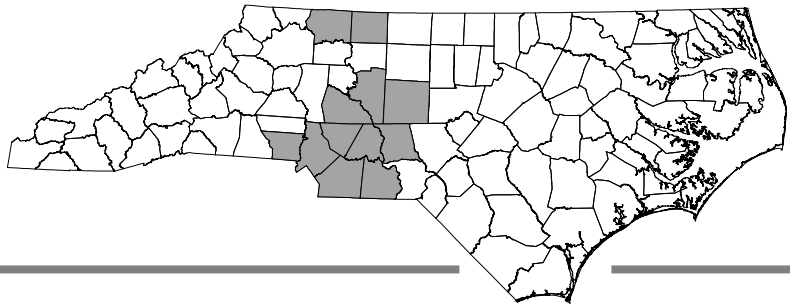


** No record has been reported in the county for the past 20 years.*

*Sources: Radford et al. 1964; Smith 1992; USFWS 1992a, 1995c.*

# Schweinitz' s sunflower

*Helianthus schweinitzii*
Endangered (June 7,1991)

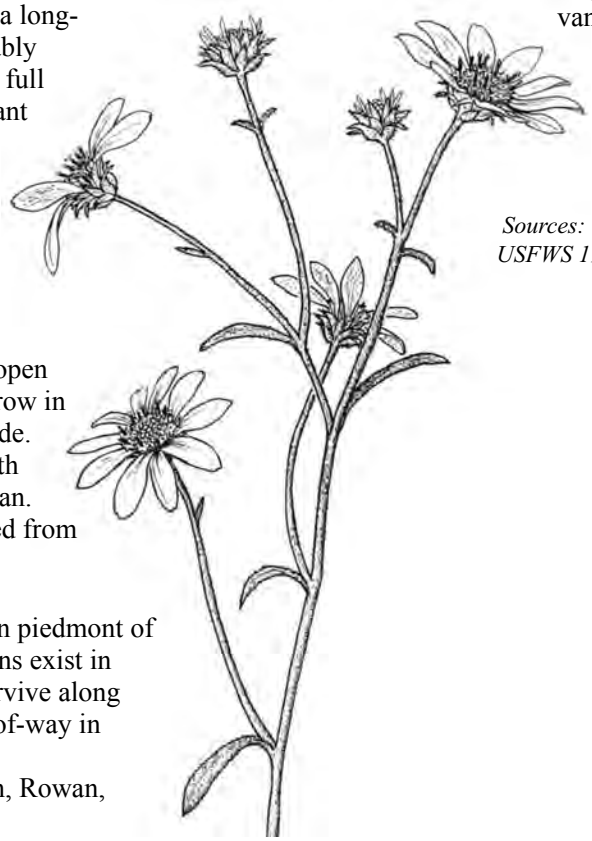


**Description:** Schweinitz's sunflower is a perennial rhizomatous herb with one to several hairy purple stems growing from a cluster of carrot-like tuberous roots. It is usually 3.2-6.5 feet (1-2 m) tall, but may grow up to 10 ft (3 m) high. Leaves are 2-7 inches (6-18 cm) long, 0.4-0.8 inch (1-2 cm) wide, lance-shaped, and usually opposite, with upper leaves alternate. Leaves feel like felt on the underside and rough like sandpaper on the upper surface. Leaf edges tend to curl under. Flowers are yellow composites which are relatively smaller than those of other sunflowers in North America. Nutlets are dark brown 0.13-0.14 inch (3.3-3.5 mm) long with a blunt tip.

**Life History:** Plants sprout from tubers in March and April; seeds germinate at the same time. Vegetative growth continues through the summer. Flowering and fruiting occur mid-September to frost. This is a long-lived perennial with individuals probably living for decades. Typically grows in full sunlight or partial shade but is intolerant of full shade.

**Habitat:** Clearings and edges of upland woods, thickets, and pastures. Found along roadsides, powerline clearings, old pastures, and woodland openings. Requires disturbance (blowdowns, storm, or fire) to create open areas for full sunlight, but may also grow in open stands of trees with minimal shade. Soils may be either shallow, sandy with high gravel content, or a clayey hardpan. The sunflower may prefer soils derived from basic material.

**Distribution:** Endemic to the southern piedmont of the Carolinas. Currently, 67 populations exist in North Carolina. These populations survive along roadsides or within utility line rights-of-way in Anson, Cabarrus, Davidson, Gaston, Mecklenburg, Montgomery, Randolph, Rowan, Stanly, Stokes*, Surry, and Union counties.



**Threats:** Loss of habitat due to suppression of periodic fire regime and discontinued grazing by native herbivores, residential and industrial development, mining, encroachment by invasive exotic species such as privet, highway construction and improvement, and roadside and utility right-of-way maintenance during the growing season or with herbicide.

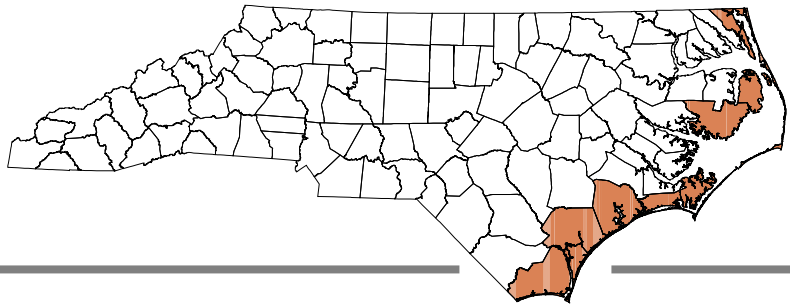
**Management Recommendations:** Protection and maintenance of habitat is most important to prevent loss of this species. The U.S. Fish and Wildlife Service and N.C. Natural Heritage Program continue to work with the North Carolina and South Carolina Departments of Transportation to protect roadside populations. The Nature Conservancy has initiated a prescribed burning program to maintain populations on their land.

** No record has been reported in this county in the past 20 years.*

*Sources: Hardin 1977; Radford et al. 1964; USFWS 1992d,1994d.*

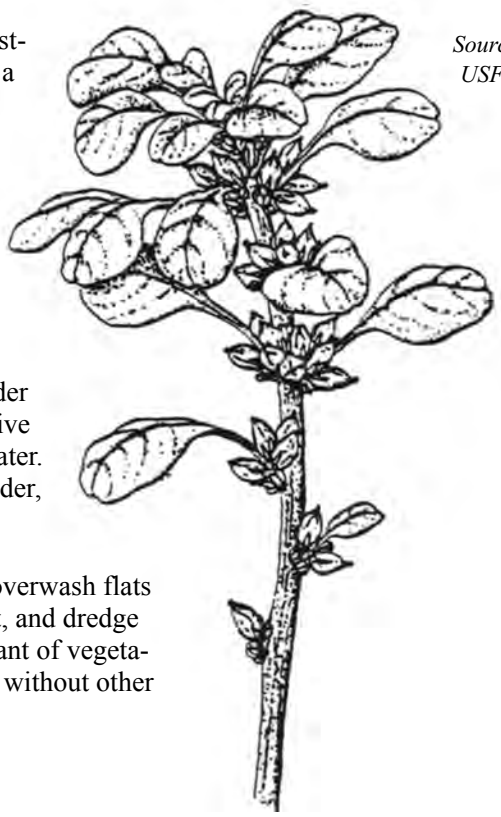
# Seabeach amaranth

*Amaranthus pumilus*
Threatened (April 7, 1993)



**Description:** Seabeach amaranth is a low-growing annual with stems that trail along the ground but do not root. The stems are pinkish-red and fleshy and grow to 4-24 inches (10-60 cm). Spinach-green leaves are thick, oval-shaped with a slightly notched or indented tip, alternate, 0.4-0.6 inch (1-1.5 cm) long, and clustered toward the tip of the stem. Petioles are winged and are about 1 cm long. Flowers grow in clusters at nodes where leaves attach to the main stalk. The fruit is small, 0.16-0.20 inch (4-5 mm) long, and smooth. Seeds are shiny black, about 0.1 inch (2.5 mm) long.

**Life History:** Flowering and fruiting occur from July to first frost, peaking in September. Seeds are enclosed in a waxy, semi-waterproof indehiscent utricle like an air-filled seed bag which allows seeds to float and be dispersed by water and wind. Germination occurs from April to July. The plant initially forms a small unbranched sprig but branches profusely into a clump, often 10-12 inches (25-30 cm) across and consisting of 5-20 branches. Occasionally a clump may grow to be 3 ft (1m) or more across with 100 or more branches. The length of the reproductive season depends on weather events including rainfall, hurricanes, temperature extremes, and predation by webworms. The flowering and fruiting seasons can be terminated by these factors as early as June or July. Under favorable conditions, the reproductive season can extend into January or later. The species is an effective sand binder, building and anchoring dunes.



**Habitat:** Upper beach, foredune, overwash flats and sand/shell beach replenishment, and dredge spoil. Seabeach amaranth is intolerant of vegetative competition and is often found without other plants.

**Distribution:** Barrier islands of Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, and Pender counties.

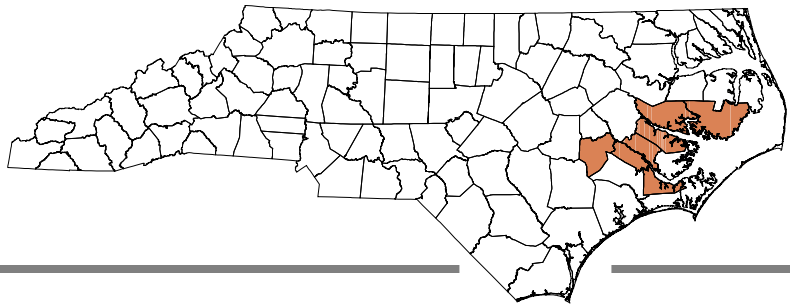
**Threats:** Seabeach amaranth is threatened throughout its range by beach stabilization structures, beach erosion and tidal inundation, beach grooming, herbivory by insects and feral animals, and by off-road-vehicles. It has been eliminated from 2/3 of its historic range.

**Management Recommendations:** On publically owned lands, including Cape Hatteras and Cape Lookout National Seashores, plants are being protected from beach armoring. Off-road-vehicle traffic is being routed around areas where plants are growing. Collection and storage of seeds and plant material has been initiated by the Center for Plant Conservation and member gardens.

*Sources: Mignogno pers. com., Radford et al. 1964, USFWS 1993b, 1996c.*

# Sensitive joint-vetch

*Aeschynomene virginica*
(Northern joint-vetch)
Threatened (June 19, 1992)

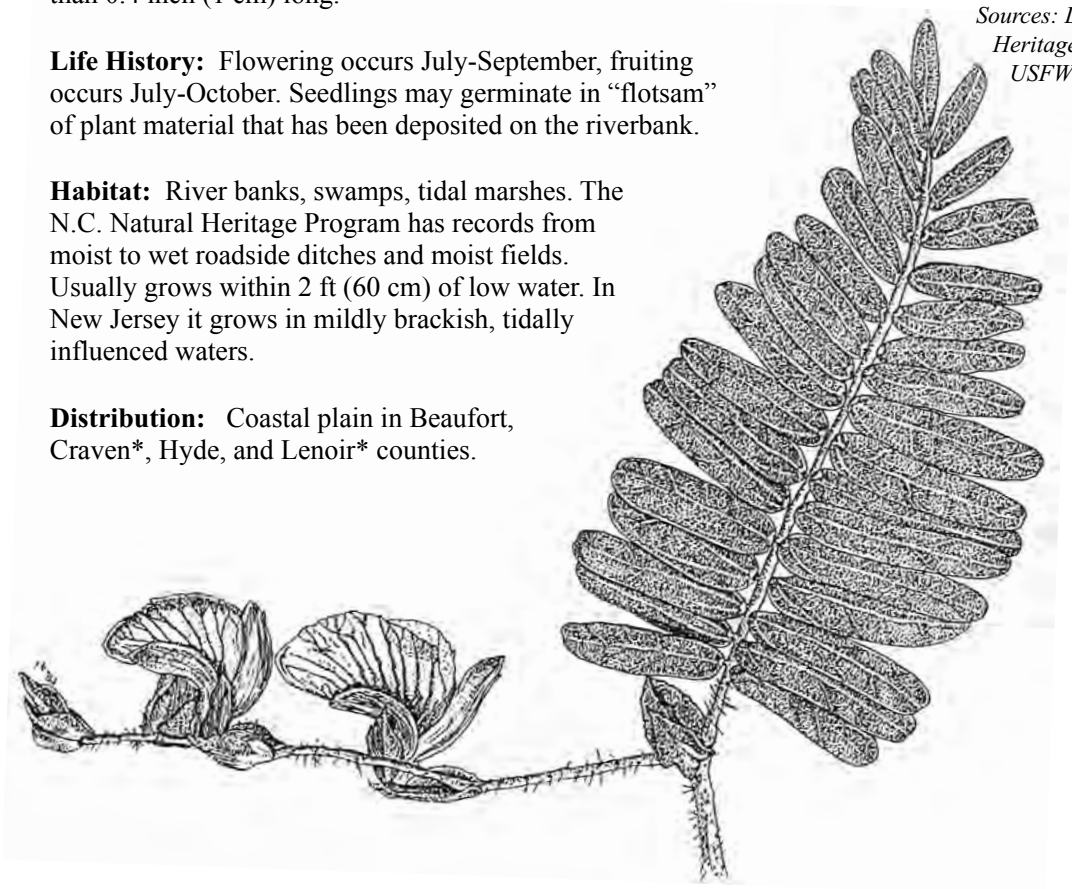


**Description:** Sensitive joint-vetch is a robust, bushy-branched annual legume, usually between 20-39 inches (0.5-1 m) tall, but can grow to be taller. It is sensitive to light and usually to touch. Stems are single and branch near the top. Leaves are compound, divided pinnately into 30-56 leaflets. The leaves are 0.8-5 inches (2-12 cm) long, the leaflets are usually no longer than 0.4 inch (1 cm) long, and 0.08-0.12 inch (2-3 mm) wide, with toothed edges. Flowers grow in a long cluster with each flower on its own short lateral stem and accompanied by reduced leaves. Petals are yellowish- to reddish-purple, about 0.4-0.6 inch (1-1.5 cm) long and irregular, legume-like. The dry fruit are legumes, 1.2-2.4 inches (3-6 cm) long, made up of about 6-10 segments that turn dark brown when ripe. Indian joint-vetch *(A. indica)* has leaflets longer than 0.4 inch (1 cm) and flowers usually less than 0.4 inch (1 cm) long.

**Life History:** Flowering occurs July-September, fruiting occurs July-October. Seedlings may germinate in "flotsam" of plant material that has been deposited on the riverbank.

**Habitat:** River banks, swamps, tidal marshes. The N.C. Natural Heritage Program has records from moist to wet roadside ditches and moist fields. Usually grows within 2 ft (60 cm) of low water. In New Jersey it grows in mildly brackish, tidally influenced waters.

**Distribution:** Coastal plain in Beaufort, Craven*, Hyde, and Lenoir* counties.



**Threats:** Habitat alteration is the primary threat. Historic sites have been dredged, filled, or bulkheaded. New threats include highway construction and expansion, residential and commercial development, water pollution and bank erosion from motorboat traffic (backwash), and piers. Sedimentation inhibits seed germination, smothers seedlings, and promotes invasion of competing weedy species. Herbicides, pesticides, and fertilizers from golf courses, lawns, and gardens degrade water quality. In NC, seed predation by tobacco budworms and corn earworms is severe.

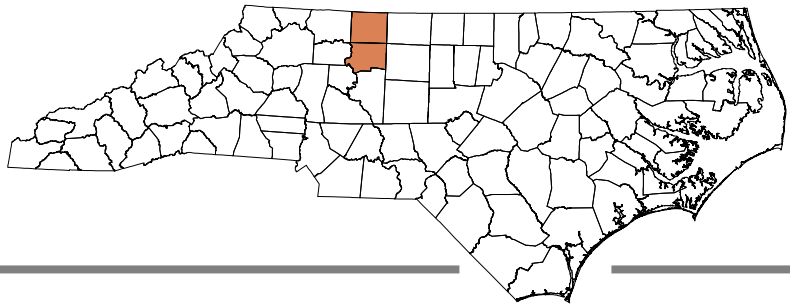
**Management Recommendations:** Protection of extant populations and habitat against pollution and destruction.

** No record has been reported in this county in the past 20 years.*

*Sources: Davidson and Bruderle 1985, N.C. Natural Heritage Program files, Radford et al. 1964, USFWS 1992a.*

# Small-anthered bittercress

*Cardamine micranthera*
Endangered (September 21, 1989)



**Description:** Small-anthered bittercress is a slender, erect herb of the mustard family, usually with one but occasionally with multiple stems, either simple or branched, 8-16 inches (20-40 cm) high. Roots are fibrous. Leaf edges have shallow, rounded teeth. Bottom (basal) leaves are lobed, 0.4-0.8 inch (1-2 cm) long, and 0.2-0.24 inch (0.5-0.6 cm) wide. Upper leaves are alternate and usually unlobed, 0.4-0.6 inch (1-1.5 cm) long, and wedge shaped, with the narrow point at the stem. Reduced leaves (bracts) occur at the base of the flowers. The flowers have four white petals, 0.08-0.12 inch (2-3 mm) long, six stamens, and small, round anthers.

**Life History:** Very little is known about the autecology of this species, including the identity of pollinators although ants have been observed on the flowers. Flowering and fruiting occur April-May. Seeds are brown, about 0.04 inch (1 mm) long.

**Habitat:** Primarily seeps and wet rock crevices of stream banks, adjoining sandbars, moist woods near small streams fully to partially shaded by trees and shrubs. Occasionally found in full sun (one population in Virginia).

**Distribution:** Endemic to the Dan River drainage in the north central upper Piedmont of North Carolina and south central Piedmont of Virginia.

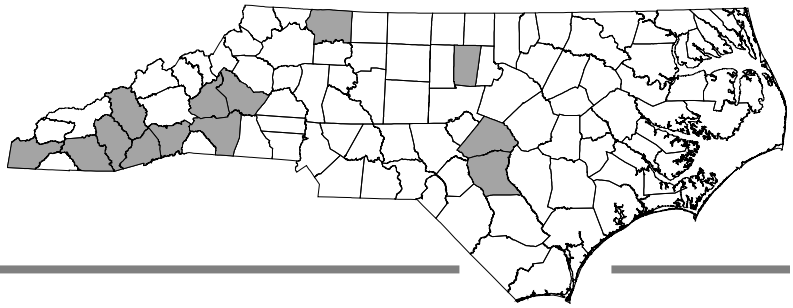
**Threats:** Scarcity of populations and small numbers of individual plants makes them especially vulnerable to disturbance from agriculture and residential development. Although all remaining populations are on private lands, they are unprotected and threatened by impoundment, channelization, natural flooding and drought, and conversion to agriculture or silviculture. Encroachment by exotic species like Japanese honeysuckle threaten habitat.

**Recommendations:** Education of private landowners; establish protection and management of sites. Search for additional populations.

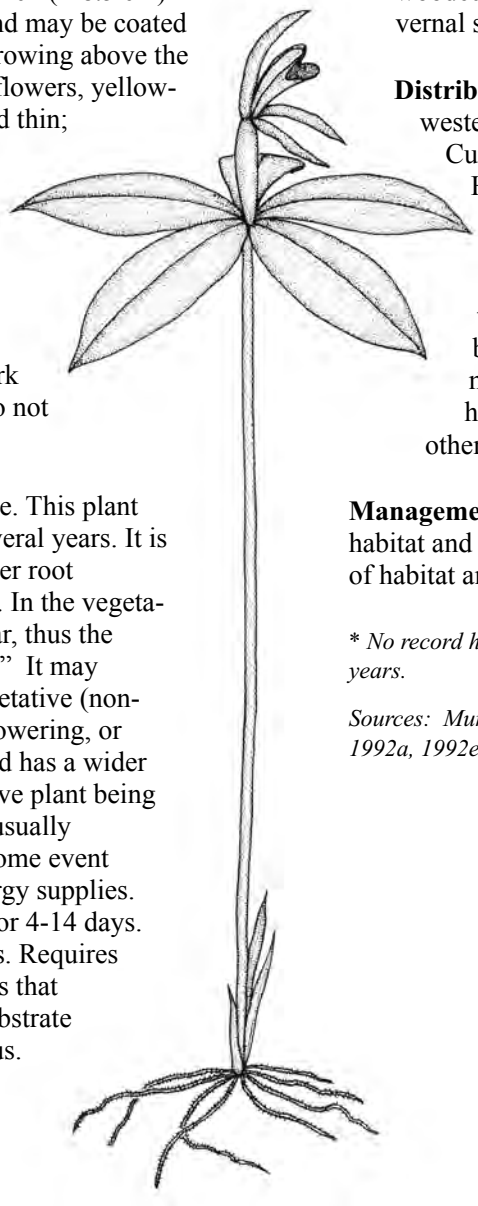
*Sources: Early 1991, Hardin 1977, Radford et al. 1964, USFWS 1991a.*

# Small whorled pogonia

*Isotria medeoloides*
(Green five-leaved orchid, small-whorled crest-lip)
Threatened (November 7, 1994;
originally Endangered, September 10, 1982)



**Description:** This orchid is a slender, perennial herb, 4-10 inches (9.5-25 cm) tall, with a greenish-tinged (rarely purplish) single hollow stem. The roots, slender, fibrous, and hairy, radiate from a crown or rootstock. At the apex of the stem is a whorl of five or six pale, dusty green leaves with parallel veins. Leaves droop, are 0.8-3.3 inch (2-8.5 cm) long and 0.4-1.6 inches (1-4 cm) wide, and may be coated with a whitish bloom (powdery layer). Growing above the leaves are one or two irregularly-shaped flowers, yellowish-green in color. The sepals are long and thin; petals are more rounded, up to 0.7 inch (1.7 cm) long and pale green. The lip (bottom petal) of the flower is greenish white, veined with green, and is three-lobed. The fruit is a dry, erect, dehiscent ellipsoid capsule, 0.7-1.2 inches (1.7-3 cm) long. Large-whorled pogonia *(I. verticillata)* often has a purplish stem, dark maroon or brown sepals, and its leaves do not droop.



**Life History:** Flowering occurs May-June. This plant may remain dormant underground for several years. It is usually found in colonies. Indian cucumber root *(Medeola virginiana)* often grows nearby. In the vegetative stage, the two plants look very similar, thus the name *medeoloides*, means "*medeola* like." It may appear in any of four different states: vegetative (non-reproductive), with an abortive flower, flowering, or dormant. The flowering plant is tallest and has a wider whorl than the other three with a vegetative plant being the smallest in size. Plants that are large usually reproduce (flower) the next year unless some event prevents them from storing adequate energy supplies. An individual plant may retain a flower for 4-14 days. Dormancy may last from 1 to 10-20 years. Requires a symbiotic root/fungus association; seeds that germinate become established only on substrate containing the suitable mycorrhizal fungus.

**Habitat:** Highly variable in North Carolina, occurring in young as well as maturing forests (second to third successional growth). Typically grows in open, dry deciduous woods and areas along streams with acid soil. Also grows in rich, mesic woods in association with white pine *(Pinus strobus)* and rhododendron *(Rhododendron* spp.*)*. Prefers leaf litter and decaying material but may be found on dry, rocky, wooded slopes, moist slopes or slope bases near vernal streams.

**Distribution:** Scattered from mountains to western coastal plain in Burke, Cherokee, Cumberland*, Harnett*, Haywood, Henderson, Jackson, Macon, Orange*, Surry*, and Transylvania counties.

**Threats:** Habitat destruction and collection are main threats. Habitat is destroyed by recreational use, residential and commercial development, road construction, and herbivory from browsing deer, rabbits, and other animals.

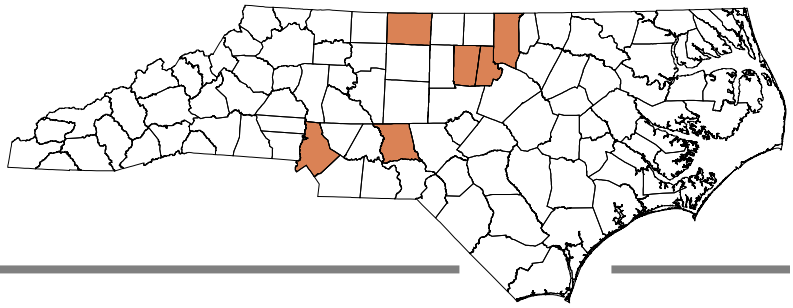
**Management Recommendations:** Protection of habitat and education of landowners on management of habitat and existing colonies.

** No record has been reported in this county in the past 20 years.*

*Sources: Murdock pers. com.; Radford et al. 1964; USFWS 1992a, 1992e, 1994.*

# Smooth coneflower

*Echinacea laevigata*
(Smooth echinacea, smooth purple coneflower, purple coneflower)
Endangered (October 8, 1992)



**Description:** Smooth coneflower is a perennial herb of the aster family with fleshy roots, hairless stems, and few leaves, 20-59 inches (0.5-1.0 m) tall. The simple leaves are alternate, smooth with toothed edges, range in shape from lance-shaped basal leaves with rounded bases to smaller, elliptic mid-stem leaves, 4-8 inches (10-20 cm) long, and 1-3 inches (3-8 cm) wide. Flowers are composite, single, and similar to black-eyed susans, with purple centers and deep to pale pink, occasionally white, drooping ray flowers (which resemble petals).

**Life History:** Flowering occurs May-July, fruiting occurs June-October. The fruit is a gray-brown, oblong achene, usually four-angled and 4-4.5 mm long and with seeds 0.5 cm long. Reproduction is predominately sexual, but asexual vegetative reproduction has been reported. Shade-intolerant. Requires bare soil for germination of seeds. Pollinators are speculated to be butterflies and bees. Seed dispersal is accomplished through seed-eating birds and small mammals.

**Habitat:** Basic or circumneutral soils of meadows, open woodlands, and border areas in between. Requires abundant sunlight, with little competition from other herbaceous plants. Known to occur in cedar barrens, open woods, dry limestone bluffs, and along roadsides and powerline rights-of-way. May prefer calcium- and magnesium-rich soils associated with gabbro and diabase parent material in xeric hardpan forests and diabase glades. Grows best where there is disturbance such as natural fires which serve to reduce shade and competition from woody plants

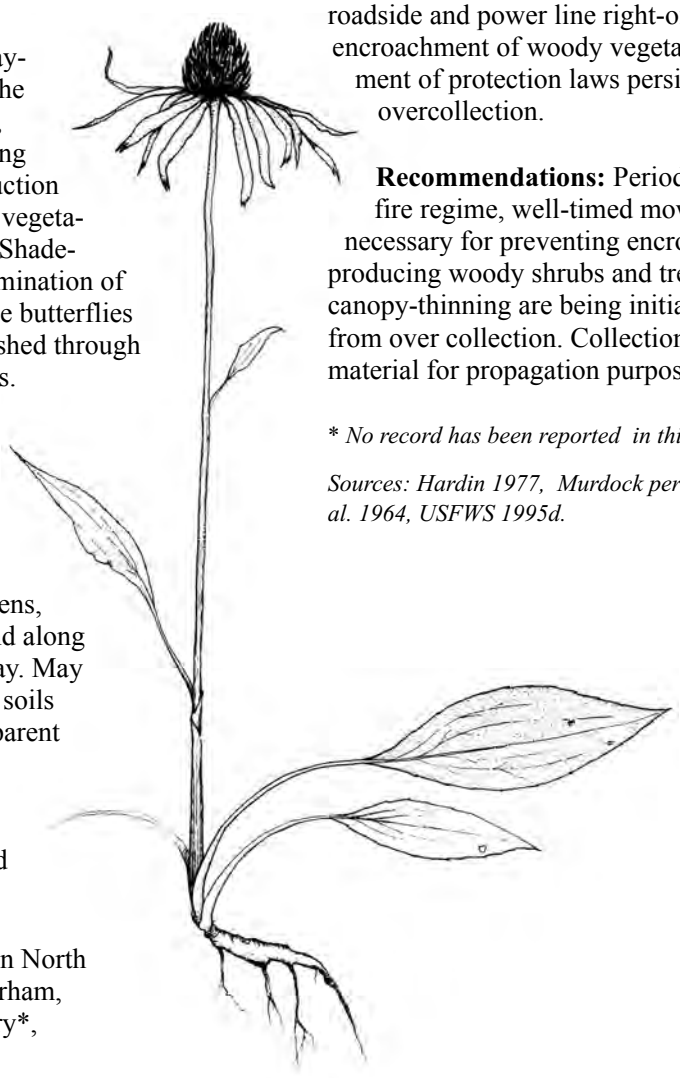
**Distribution:** Only ten populations in North Carolina (all in the piedmont), in Durham, Granville, Mecklenburg, Montgomery*, Orange*, and Rockingham counties. Most populations contain less than 100 plants.

**Threats:** Only 60 populations have been reported historically from 24 counties in 8 states. Over 2/3 of these have been eliminated. The most serious threats remaining are overcollection, habitat degradation by residential and commercial development, agricultural and silviculture practice, roadway construction and improvement, certain types of roadside and power line right-of-way maintenance, and encroachment of woody vegetation. Difficulty in enforcement of protection laws persists, especially with overcollection.

**Recommendations:** Periodic disturbance such as regular fire regime, well-timed mowing, and careful clearing is necessary for preventing encroachment of habitat by shade-producing woody shrubs and trees. Prescribed burns and canopy-thinning are being initiated in some sites. Protection from over collection. Collection and storage of seed and plant material for propagation purposes.

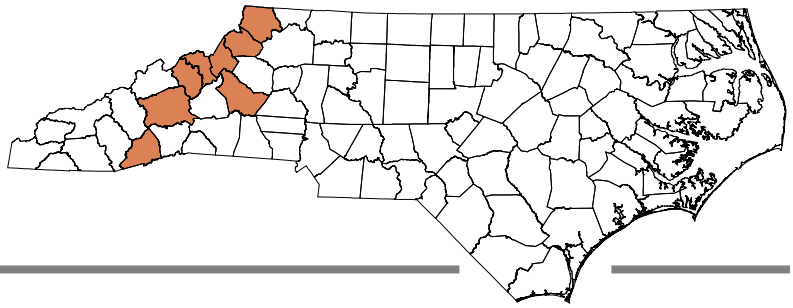
** No record has been reported in this county in the past 20 years.*

*Sources: Hardin 1977, Murdock pers. com., Murdock 1992, Radford et al. 1964, USFWS 1995d.*



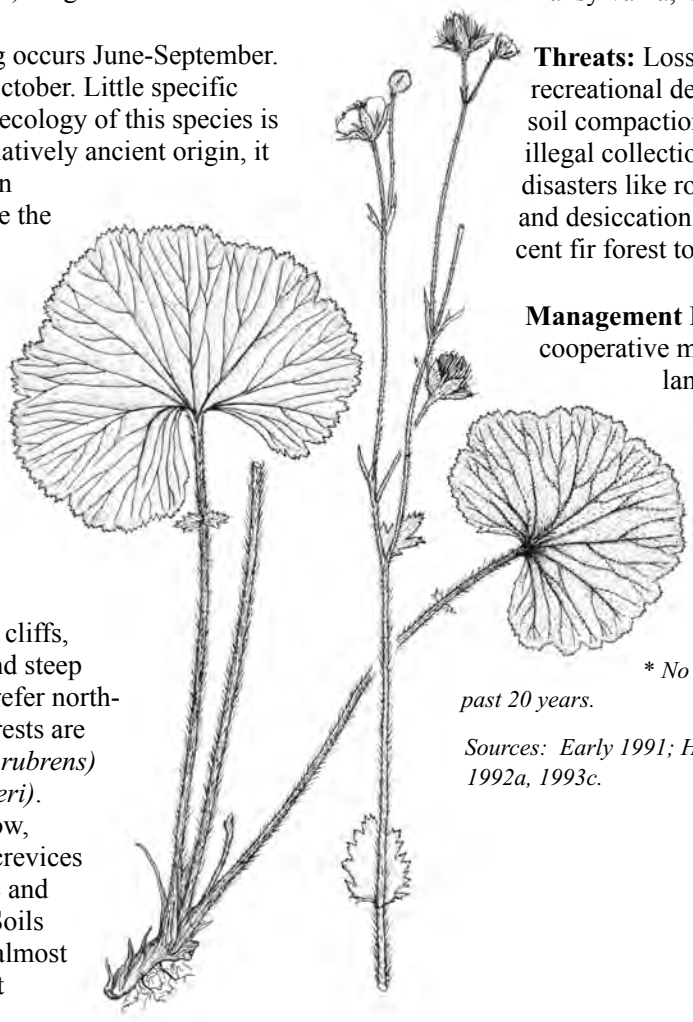
# Spreading avens

*Geum radiatum*
(Appalachian avens, cliff avens)
Endangered (April 5, 1990)



**Description:** Spreading avens is a perennial herb of the rose family, 8-20 inches (20-50 cm) high, with dense spreading hairs. Most leaves grow from a rosette at the plant base, which arises from horizontal rhizomes. These leaves are large and kidney shaped, with uneven, toothed edges. Two to five smaller leaves grow from the plant stems. An indefinite cyme of 1-3 flowers grows at the end of each stem, with 5 lance-shaped sepals, and 5 bright yellow petals 0.5-0.8 inch (1.3-2 cm) long, with numerous stamens and pistils. Fruit is a small, dry, and hairy achene, with a 0.1-0.12 inch (2.5-3 mm) long body, and a 0.4 inch (1 cm) long beak.

**Life History:** Flowering occurs June-September. Fruiting occurs August-October. Little specific information about the autecology of this species is available. A species of relatively ancient origin, it has existed in the southern Appalachians since before the last Ice Age. Exists in small, isolated populations and grows in pioneer perennial herb communities. Reproduces sexually (seed) and asexually by rhizomes. Probably pollinated by insects drawn to the showy flowers.



**Habitat:** High-elevation cliffs, outcrops, grassy balds, and steep slopes in full sun. May prefer north-facing cliffs. Adjacent forests are mostly red spruce *(Picea rubrens)* and Fraser fir *(Abies fraseri)*. Known substrate is shallow, acidic soil in cracks and crevices of igneous, metamorphic and metasedimentary rocks. Soils may be well drained but almost continuously wet. Soils at some sites are subject to drying out in summer due to exposure to sun and shallow depths. Blue Ridge goldenrod, Heller's blazing star, and Roan Mountain bluet, all of which are federally listed species, may be found in association with spreading avens.

**Distribution:** Found in the mountains of North Carolina and eastern Tennessee, there are only 11 of 16 original sites left. Seven of these support less than 50 plants each, and 3 of those sites support less than 10 individuals. Reported in North Carolina in Ashe, Avery, Buncombe, Burke*, Mitchell, Transylvania, Watauga, and Yancey counties.

**Threats:** Loss of habitat because of residential and recreational development; trampling (and resulting soil compaction) by hikers, climbers, and sightseers; illegal collection; and natural succession. Natural disasters like rock slides, severe storms and drought, and desiccation of moist soils due to loss of the adjacent fir forest to the balsam wooly adelgid.

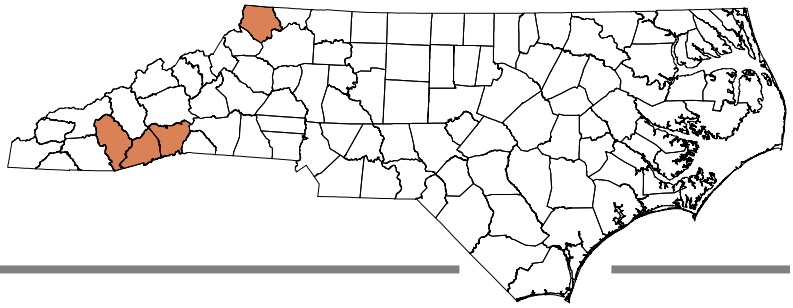
**Management Recommendations:** Education and cooperative management effort by public and private landowners. Protection of existing sites by erecting barriers around populations at heavily visited sites. Avoid new construction of recreational and residential facilities at sites. Research of life history and management requirements. Restoration to historic sites; search for additional populations.

** No record has been reported in this county in the past 20 years.*

*Sources: Early 1991; Hardin 1977; Radford et al. 1964; USFWS 1992a, 1993c.*

# Swamp pink

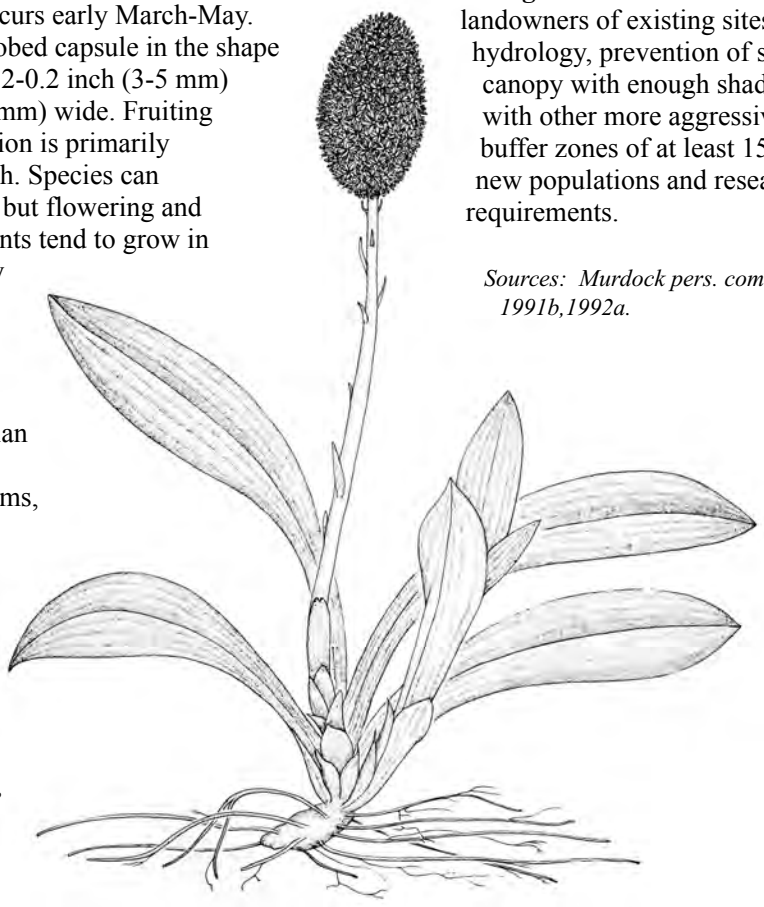
*Helonias bullata*
Threatened (September 9, 1988)



**Description:** Swamp pink is a perennial herb in the lily family growing to 12 inches (30 cm) tall from a stocky underground rhizome. During seed maturation, the flower stalk can grow up to 5 ft (1.5 m) tall. Strap-like leaves are lance-shaped, evergreen, with a pointed tip and parallel veins, up to 10 inches (25 cm) long and 0.8-1.6 inches (2-4 cm) wide, and grow from a rosette at the base of the plant. Thirty to fifty fragrant flowers grow in a tight cluster at the end of a thick stalk. The cluster is 1-3 inches (3-8 cm) long. Each flower has 6 petals and 6 sepals, and is colored pink to lavender. Leaves turn reddish brown in winter and lie mostly flat on the ground, sometimes hidden by leaf litter. A large button in the center of the leaves holds the flower head for next season.

**Life History:** Flowering occurs early March-May. The fruit is a papery, three-lobed capsule in the shape of an upside-down heart, 0.12-0.2 inch (3-5 mm) long and 0.3-0.4 inch (8-10 mm) wide. Fruiting occurs June-July. Reproduction is primarily asexual by clonal root growth. Species can reproduce sexually by seeds but flowering and seed dispersal is limited. Plants tend to grow in clumps due to clonal activity and populations are very slow to expand.

**Habitat:** Variety of wetland habitats including Appalachian bogs and swamps, swampy forests bordering small streams, boggy meadows, and spring seepage areas. Requires constant saturated, but not flooded, forest habitat. Commonly associated with some evergreens, including pitch pine *(Pinus rigida)*, Atlantic white cedar, American larch, black spruce, red spruce, and with red maple. Often grows on hummocks formed by trees, shrubs, and sphagnum moss. The hummocks keep the roots moist but not submerged.



**Distribution:** Southern mountain region in Ashe, Henderson, Jackson, and Transylvania counties.

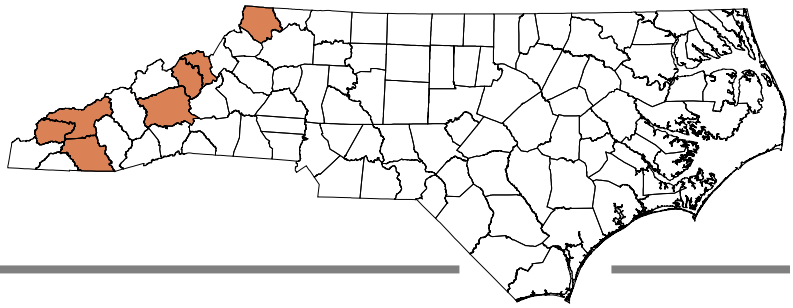
**Threats:** Wetland loss to urban, agricultural, and silvicultural development; habitat degradation (esp. siltation) from off-site disturbance including groundwater withdrawal, sewage discharge, siltation from soil erosion, and introduction of excess nutrients and toxic chemicals; collection; trampling by humans and livestock; competition from exotic plants; intensive livestock grazing and resultant over-fertilization.

**Management Recommendations:** Education of private landowners of existing sites about protection of site hydrology, prevention of siltation, maintaining a thin canopy with enough shade to minimize competition with other more aggressive species, and providing buffer zones of at least 150 meters wide. Searches for new populations and research to study specific habitat requirements.

*Sources: Murdock pers. com.; Radford et al. 1964; USFWS 1991b,1992a.*

# Virginia spiraea

*Spiraea virginiana*
Threatened (July 16, 1990)



**Description:** Virginia spiraea is a perennial shrub of the rose family that grows 2-10 ft (0.6-3 m) tall, with arching, upright stems. Leaves may be shaped in a narrow ellipse, with a tapered base and a short bur at the end of the tip; leaf shape can be variable, however. Edges may be toothed. There is a whitish bloom (powdery layer) on the leaf undersurface. The flowers grow in flat-topped clusters at the ends of a branching stalk. There are 5 petals and sepals. Petals are white, occasionally pink, 0.04-0.12 inch (1-3 mm) long. Plants may grow in dense clumps.

**Life History:** Flowering occurs late May-July. The fruit is dry, smooth and glossy, 0.1-0.12 inch (2.5-3 mm) long. The seeds are long and narrow, 0.07-0.08 inch (1.8-2 mm) long, with a dull pebbled surface and a slender tail. Fruiting occurs August-September. Species is rare because it reproduces asexually, has a narrowly defined habitat niche subject to natural disturbance, limited opportunities for colonization, and competition from other species. Although seeds are plentiful in number, few mature. There has been little success in attempts to propagate seeds.

**Habitat:** Flood-scoured, high-gradient rocky riverbanks; braided areas of lower stream reaches, gorges, and canyons; as well as disturbed rights-of-way. Grows in thickets, in association with a variety of grape species *(Vitis* spp.*)* and royal fern *(Osmunda regalis)*, among other plant associations. Occurs in sunny areas on moist, acid soils, primarily over sandstone. Habitat is critical and restricts the species to a narrow ecological niche.

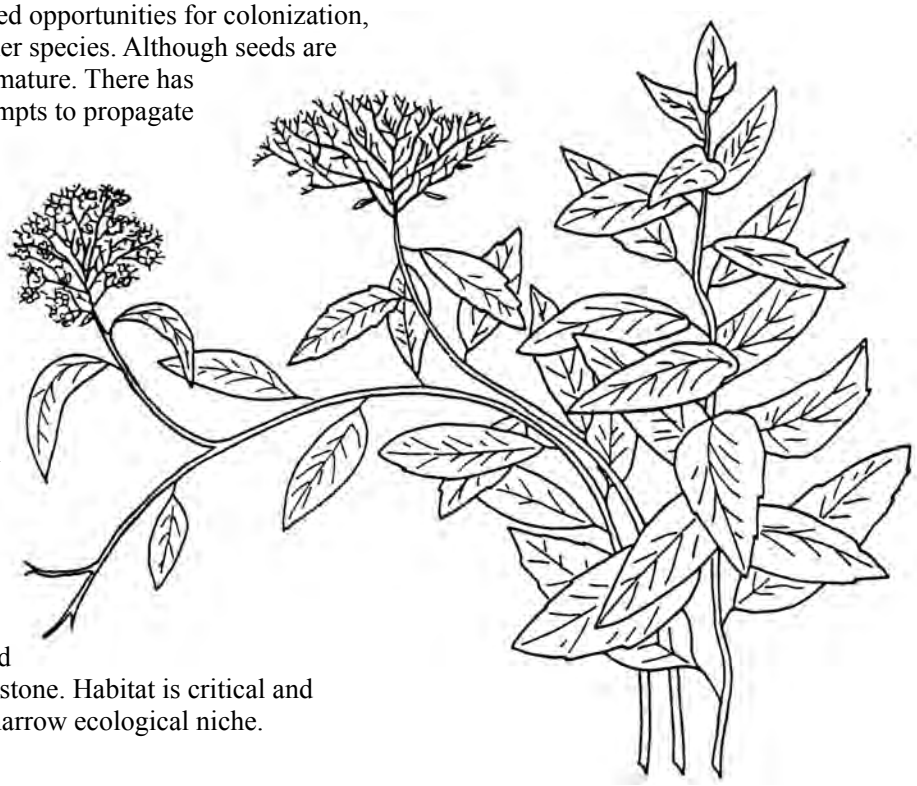
**Distribution:** Mountains in Ashe, Buncombe*, Graham, Macon, Mitchell, Swain, and Yancey counties.

**Threats:** Human disturbance to critical habitat and small populations by reservoir, highway, and railroad maintenance and construction resulting in erosion, severe flooding or inundation; dumping; and clearing of pathways to rivers and streams by hikers and rafters.

**Management Recommendations:** Protection of populations and habitat on federal and state lands; education of private landowners; and secured voluntary protection by easements and registration.

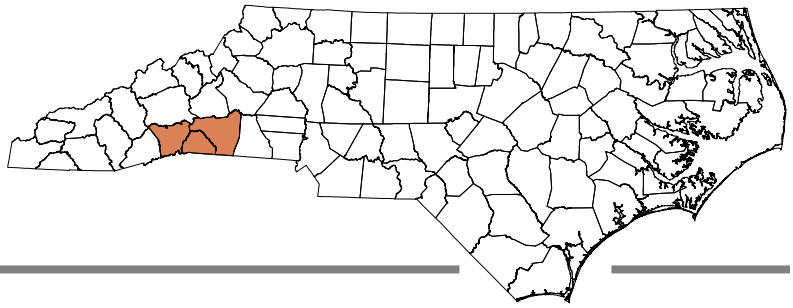
** No record has been reported in this county in the past 20 years.*

*Sources: Radford et al. 1964, USFWS 1992a.*



# White irisette

*Sisyrinchium dichotomum*
Endangered (September 26, 1991)



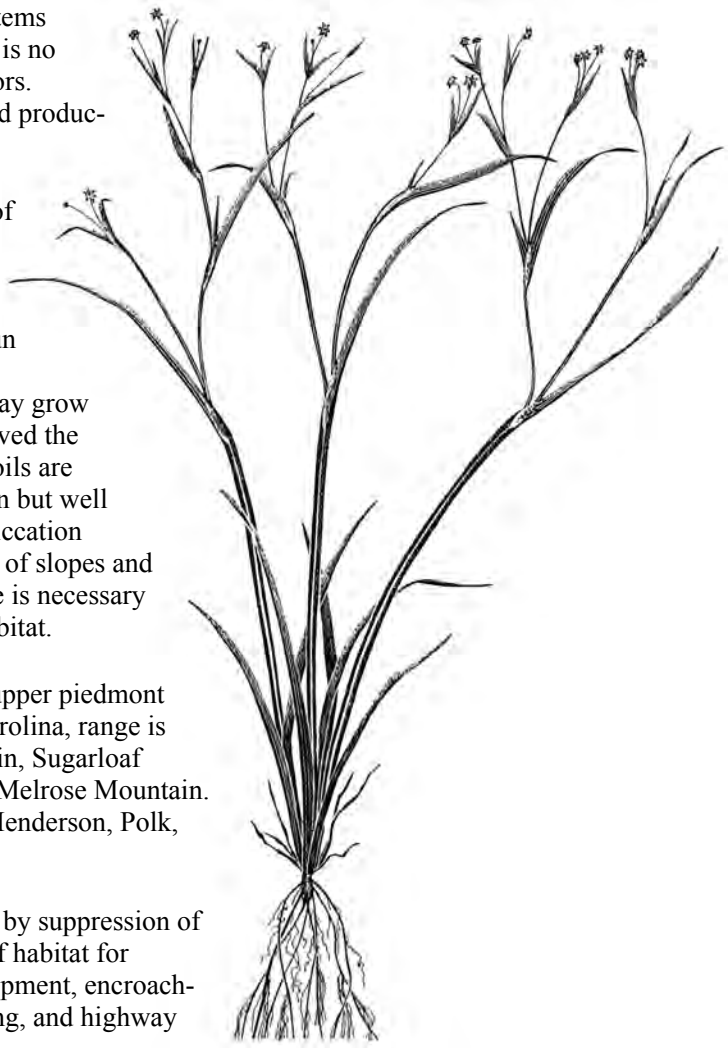
**Description:** White irisette is a perennial herb with dichotomously branching stems, 4-8 inches (11-20 cm) tall. Leaves at the base of the plant are pale to bluish green and grow to one-third to one-half the height of the plant. The flowers are tiny, 0.3 inch (7.5 mm) long, occurring in clusters of 4 to 6 at the tops of winged stems. The fruit is a pale to medium brown capsule containing 3 to 6 rounded black seeds.

**Life History:** Flowering occurs late May-July. Little is know of the autecology of this species. An individual plant is a cluster of stems rising from fibrous roots. There is no data on pollinators or seed vectors. Pollen has 63% fertility and seed production is low.

**Habitat:** Clearings and edges of upland woods with a thin canopy. Also found in road/powerline rights-of-way. Prefers partial shade to direct sun and rich, basic soils, probably weathered from amphibolite. May grow on sites where run-off has removed the usual deep layer of leaf litter. Soils are intermittently saturated with rain but well drained. Plants are prone to desiccation because of aspect and steepness of slopes and shallowness of soil. Disturbance is necessary to maintain a relatively open habitat.

**Distribution:** Endemic to the upper piedmont of North Carolina and South Carolina, range is bounded by White Oak Mountain, Sugarloaf Mountain, Chimney Rock, and Melrose Mountain. Reported in North Carolina in Henderson, Polk, and Rutherford counties.

**Threats:** Endangered primarily by suppression of natural disturbance, alteration of habitat for industrial and residential development, encroachment by exotic species, trampling, and highway construction and improvements.

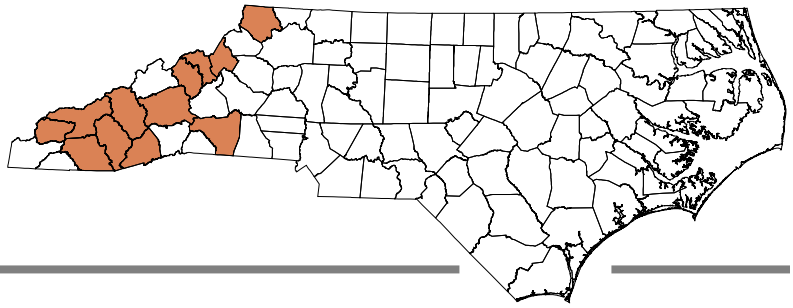


**Management Recommendations:** Two of the remaining eight populations in North Carolina are within highway rights-of-way (one maintained by NC DOT and one privately maintained in a community recreational area); one population is along a private road right-of-way and underneath a powerline; and a fourth population is adjacent to a secondary road. Populations of *Sisyrinchium dichotomum* that occur in right-of-ways need control of invasive exotic plants. Any maintenance of the row should be done during the dormant season, generally from 31 October to 31 March. Research is ongoing to determine best management practices, including the effects of prescribed fire.

*Sources: Murdock 1991; Murdock pers. com.; USFWS 1991c, 1992a, 1995f.*

# Rock gnome lichen

*Gymnoderma lineare*
Endangered (February 5, 1995)



**Description:** The rock gnome lichen of the reindeer moss family grows in dense colonies of narrow, strap-like lobes, called squamules. The squamules are blue-gray on the upper surface and usually shiny white on the lower surface. Near the base of the lobe, the color darkens to black. The slightly branched squamules are less than 0.04 inch (1 mm) across near the tip, and are usually 0.4-0.8 inch (1-2 cm) long. The squamules grow parallel to the substrate, but the tips curl up almost perpendicularly. The small fruiting bodies (apothecia) occur at the tips of the squamules from July-September. They are colored black or brown, and are no larger than 1 mm across. The fruiting bodies may be sessile, or they may be carried on short stalks (podetia) less than 0.1 inch (1-2 mm) in height. The fruiting bodies are shaped like cylinders. Similar-looking lichens in the genus Cladonia do not blacken near the base and have brown or red fruiting bodies.

**Life History:** Very little is known of the life history and population biology of this species. Growth rates and distribution mechanism are not known. Small size of colonies and slow growth rate makes it vulnerable to extirpation by collecting and natural disturbance (slides, floods, drought). Almost always found in association with moss *Andreaea* (and/or *Grimmia*).

**Habitat:** The rock gnome lichen only grows in areas with a great deal of humidity, such as high elevations above 5,000 feet where there is often fog, or in deep river gorges at lower elevations. Habitat is restricted to vertical rock faces occasionally exposed to seepage water. Does well on moist, generally open sites with northern exposures but needs partial canopy coverage on southern or western aspect because it is intolerant of high-intensity solar radiation. High-elevation coniferous forests, red spruce and Fraser fir, usually on rocky outcrop or cliff habitat**.**

**Distribution:** Endemic to the southern mountains of Tennessee, North Carolina, South Carolina and Georgia. Only 35 populations are known to exist and most are 1 square meter or less in size. The only member of its genus in North America. Populations reported in Ashe, Avery, Buncombe, Graham, Haywood, Jackson, Macon, Mitchell, Rutherford, Swain*, Transylvania, and Yancey counties.

**Threats:** Collection, trampling by hikers, climbers, and sightseers. Destruction of Fraser fir forests by exotic insect pests causing changes in the microclimate (increased temperatures) and eventual desiccation of habitat. Logging.

**Management Recommendations:** Protection of plants and habitat from pollution and trampling. Increase public awareness. Encourage landowners to ensure protection and management of site. Monitor for collection, and reroute trails.

** No record has been reported in this county in the past 20 years.*

*Source: Murdock, no date; USFWS 1995b, 1997b.*

# Appendix A:
# Other Federally Listed Species of North Carolina

The following species are not described in this book because they occur here only during migration, are marine species, or are believed to be extirpated. Also, the Saint Francis' satyr butterfly (*Neonympha mitchellii francisci*) is omitted because all known populations are found on Ft. Bragg, which can provide information upon request.

| | | |
|---|---|---|
| American burying beetle | *Nicrophorus americanus* | E* |
| Atlantic Ridley sea turtle | *Lepidochelys kempii* | E |
| Bachman's warbler | *Vermivora bachmanii* | E* |
| Cumberland bean (a mussel) | *Villosa trabalis* | E* |
| Eskimo curlew | *Numenius borealis* | E#* |
| Finback whale | *Balaenoptera physalus* | E |
| Gray bat | *Myotis grisescens* | E |
| Gray wolf | *Canis lupus* | E |
| Hawksbill sea turtle | *Eretmochelys imbricata* | E |
| Humpback whale | *Megaptera novaeangliae* | E |
| Leatherback sea turtle | *Dermochelys coriacea* | E |
| Ivory-billed woodpecker | *Campephiluls principalis* | E* |
| Kirtland's warbler | *Dendroica kirtlandii* | E# |
| Oyster mussel | *Epioblasma capsaeformis* | E* |
| Right whale | *Eubalaena glacialis* | E |
| Sei whale | *Balaenoptera borealis* | E |
| Sperm whale | *Physeter catadon* | E |

**#** migrant only
**E** Endangered
**T** Threatened
**E*** believed extirpated from North Carolina

# Appendix B: Glossary of Terms

**Achene**: A dry, single-seeded fruit that does not have an opening. Example: hickory nut

**Alternate leaves**: Characteristic of plant in which single leaves are on opposite sides of a stem but at different levels (may apply to branches also).

**Annual**: A plant that completes its life cycle (germination, reproduction, death) in one season or year.

**Anther**: Part of the stamen (male filament of a flower) that bears pollen.

**Anterior**: The front of an organism; usually head.

**Autecology**: Biological relationship between a single species and its environment; ecology of a single organism.

**Bivalve**: A mussel with two hinged shells, such as a clam.

**Bloom**: A waxy layer on the surface of certain fruits, such as grapes; a blossom or flower.

**Boreal**: Similar to that found in the north (geographical area).

**Brackish**: Mixture of fresh and salt water.

**Canopy**: Highest layer of vegetation in a forest, usually of tree tops.

**Capsule**: A dry fruit that opens and sheds its contents.

**Carapace**: Upper half of a turtle shell.

**Carnivore**: Flesh-eating animal; certain plants that trap and digest insects and other small animals are considered "carnivorous" (example: pitcher plants).

**Carolina bay**: A coastal plain wetland habitat of unknown origin with a distinct oval/elliptical shape and depressed in the ground.

**Chelicerae**: Pair of appendages, at the extreme anterior of an arachnid, that are modified into fangs to inject poison into prey.

**Compound leaf**: A leaf made up of more than one leaflet on a common stem.

**Coniferous**: Cone-bearing tree, usually evergreen.

**Critical habitat**: Geographical area where an endangered or threatened species occurs at the time it is listed, which is essential for conservation of the species; may require special management considerations. Not all listed species have designated critical habitat. (Federal designation.)

**Cyme**: An inflorescence type characterized by flowers that bloom from the center outward or apex down.

**Diabase**: A fine-grained rock of altered basalt (igneous).

**Dioecious**: Having the male and female flowers on separate plants.

**Disjunct population**: Population separated from the species' primary range by 300 miles or more.

**Dorsal**: The back surface of an organism (in bivalves, the side where the shells hinge).

**Early succession**: The first stages of plant growth in an area where the vegetation has been cleared; primary succession.

**Ecotone**: Vegetation transition zone between ecological communities.

**Emergent plants**: Plants that grow up out of, and above, the water's surface.

**Endangered**: In danger of extinction throughout all or a significant portion of (a species') range.

**Endemic**: A native of, and restricted to, a limited area.

**Extant**: Currently existing; not destroyed or lost.

**Extirpated**: Completely exterminated from an area.

**Exotic**: Not native to a locality; imported.

**Fecundity**: The capacity of an individual or a species to multiply rapidly.

**Filament**: Stalk that holds the pollen-bearing organ in a flower.

**Foredune**: Base of a beach dune nearest the ocean.

**Habitat**: The particular type of environmental circumstance, often highly specific in character, in which individuals or populations of a species of animal or plant typically live.

**Herb**: Seed-producing plant with nonwoody green stem.

**Herbaceous**: Plants having the characteristics of an herb.

**Herbivore**: An animal that feeds exclusively on plants.

**Hydrology**: The properties, distribution, and circulation of water on the surface of the land and in the soil and underlying rocks.

**Hydric**: Having an abundance of moisture.

**Indigenous**: Native, belonging to the locality.

**Lanceolate**: Tapering, widest near the base.

**Lateral tooth**: A tooth that flanks or is posterior to the hinge of a bivalve.

**Leaflet**: Any of the single pieces or blades of a compound leaf.

**Length**: For animals, measured from head to tail. For leaves,

does not include leaf stem (petiole).

**Lichen**: An organism made up of fungi and algae in a mutually dependent relationship. Not a true plant.

**Lobe**: Area of a leaf that is bordered by deep, widely spaced indentations.

**Mesic**: Environment with a balanced or intermediate supply of moisture; neither wet (hydric) nor dry (xeric).

**Mollusk** (mollusc): Group of invertebrates with a soft, unsegmented body and hard shell.

**Monoecious**: Having male and female flowers on the same plant.

**Mussel**: A bivalve mollusk.

**Omnivore**: Animal that eats both plant and animal tissue.

**Opposite arrangement**: An arrangement of leaves on a stem or petiole where single leaves are opposite each other but on the same level thereby forming a pair. Also applies to branches.

**Palmate**: Divided so that leaflets point outward like fingers on a hand.

**Perennial**: A plant that lives for longer than one year; may take longer than one year or season to complete the life cycle.

**Petiole**: The stem at the base of a leaf.

**Pinnate**: Leaflets arranged along each side of a common stem like a feather.

**Pistil**: A component of the female reproductive part of a flower; composed of a stigma, style, and placenta.

**Plastron**: Lower half of a turtle shell.

**Pocosin**: A nonriverine (non-alluvial) wetland located in the coastal plain, dominated by evergreen shrubs over peat soil.

**Posterior**: Rear half of an organism.

**Proposed Species**: Species that is proposed for federal endangered or threatened status; receives the same protec tion as species already listed federally.

**Pseudocardinal tooth**: Anterior pair of hinge teeth found in certain bivalves.

**Rhizome**: An underground, horizontal shoot that a plant uses to propagate itself.

**Riffle**: Shallow rapids in a stream where water breaks into waves.

**Scute**: Large horny scale or plate (example: outer surface of turtle shell).

**Secondary succession**: The pattern of changing plant community composition that occurs over time following interruption of primary succession.

**Sepal**: Part of a flower located below the petals, which may green or colored like a petal. The sepals of a flower are collectively called the calyx.

**Serrated**: Toothed or saw-like, as in some leaf margins.

**Sessile**: A leaf attached to the plant stem at its base, without a leaf stem (petiole).

**Speciation**: The process of evolution of new species.

**Spinnerets**: In spiders, the organ perforated with tubes that connects silk-producing glands, enabling liquid silk to be released for use in building webs and encasing prey.

**Stamen**: Male reproductive part of a flower, consisting of a stalk bearing an anther in which pollen is produced.

**Stolon**: An aboveground shoot that a plant uses to propagate itself.

**Substrate**: The material or surface upon which an organism lives.

**Succession**: The sequence of different natural communities (especially plant communities) that develops over time in the same area, leading to a dynamic climax community.

**Teeth**: In mussels, a set of interlocking ridges that enable the two shells to close tightly.

**Threatened**: Likely to become endangered in the near future.

**Understory**: Vegetation layer between canopy and the ground cover in a forest; composed of shrubs and small trees.

**Valve**: One shell from a bivalve mollusc, such as a clam shell.

**Ventral**: Pertaining to the abdominal side of an animal.

**Whorl**: Circle of leaves or flowers around a stalk on the same level.

**Winged**: A flat extension. Often runs along the length of a plant stem.

**Xeric**: Dry, arid conditions.

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# Appendix D: Illustration Credits

**Abbreviations Key**

NC ZP = North Carolina Zoological Park
NCSMNS = North Carolina State Museum of Natural Sciences
NC NHP = North Carolina Natural Heritage Program
NC WRC = North Carolina Wildlife Resources Commission
USFWS = U.S. Fish and Wildlife Service

**Animals**

| | |
|---|---|
| Carolina northern flying squirrel | Courtesy of NC WRC |
| Eastern cougar | Courtesy of NC WRC |
| Indiana bat | Ruth Braswell |
| Red wolf | Courtesy of NC WRC |
| Virginia big-eared bat | Courtesy of NC WRC |
| West Indies manatee | Courtesy of NC WRC |
| Bald eagle | Courtesy of NC WRC |
| Piping plover | Julie Zickafoose; Permission of USFWS and NC NHP |
| Red cockaded woodpecker | Permission of USFWS |
| Roseate tern | Permission of Matt Burne, artist |
| Wood stork | Courtesy of Florida Power and Light Company |
| American alligator | Renaldo Kuhler; Permission of NCMNS |
| Bog turtle | Courtesy of NC WRC |
| Green sea turtle | Renaldo Kuhler; Permission of NCMNS |
| Loggerhead turtle | Renaldo Kuhler; Permission of NCMNS |
| Cape Fear shiner | Permission of Edward F. Menhinick |
| Shortnose sturgeon | Courtesy of NC WRC |
| Spotfin chub | Permission of Edward F. Menhinick |
| Waccamaw silverside | Permission of Edward F. Menhinick |
| Tar spinymussel | Courtesy of NC WRC |
| Noonday globe (snail) | Courtesy of R. Biggens, USFWS |
| Spruce-fir moss spider | Permssion of USFWS |

**Plants**

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|---|---|
| Blue Ridge goldenrod | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Bunched arrowhead | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Harperella | J. Thomas; Permission of Maryland Natural Heritage Program |
| Heller's blazing star | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Mountain golden heather | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Mountain sweet pitcher plant | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Small-whorled pogonia | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Spreading avens | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
| Swamp pink | Courtesy of USDA Forest Service, Southern Research Station (Gen. Tech. Rep. SE-20) |
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